INTRODUCTION

Foresters in many parts of California, especially the Sierra Nevada and north-Central part of the state (Figure 1), frequently encounter historic archaeological features and artifacts dating to the Gold Rush period on their Timber Harvest Plans. Stationary features often take the form of mining ditches, old mineshafts, placer deposits, or hydraulic mining tailings. Less commonly found are the dumps and sometimes even the foundations of old buildings that are all that are left of mining camps and towns of 140 years ago. Such places may have had populations in the thousands during the 1850's, but were usually abandoned as soon as the gold ran out, long before 1900. Sometimes the forester is the first person to return to such a location since its abandonment; more often, the old mining districts have been logged once, twice, even three times since the gold miners gave up and moved on.

The California Gold Rush was the central event of California, if not all Western United States, history. Although gold had been discovered in California as early as 1842 in the Sierra Pelona north of Los Angeles, then as now, it cost more than the gold was worth to extract it and process it in this water-poor area, and nothing beyond a mild curiosity was engendered in the find. The second discovery of gold, some six years later, in early 1848, was different. James Marshall's discovery of gold at Sutter's Mill was almost unbelievevably coincidental with California's change of ownership as a result of the Anglo-American victory in the Mexican War, and came at a time when many adventurers had come to California in the vanguard of military conquest (Caughey, 1948; Cutter, 1949; Holliday, 1981.

Neither Sutter, Marshall, nor any of their associates could know that Sutter's attempt at lumbering on the American River would result in a more complete change in the character of California than that produced by the Mexican War (R. Dillon, 1967). If gold had not been discovered, California may have remained an essentially Hispanic territory of the United States of little value or interest to the rest of the English-speaking residents of the country, possibly becoming a state at the same time as its neighbor, Arizona (1912), possibly not. Instead, California became not only a bastion of United States culture and technology on the Pacific Coast, and a state by 1850, but also the magnet that attracted the Anglo-American exploration and colonization of all adjacent regions as well. Everybody came to California to get rich, but very few actually did. On the other hand, many of the gold rush argonauts from the Eastern States, from Europe, Asia, Latin America, even Australia, stayed, and California became the most cosmopolitan place on earth (Browne, 1961; Carson, 1852; Harris, 1960; Jackson, 1970).

Farquhar (1965: 65) calculates that whereas the Anglo-American population of California may have been 2,000 at the beginning of 1848, by the end of 1849 it had exploded to over 53,000. R.B. Mason, military governor of California, estimated that in July of 1848 some 4,000 people were working the placer deposits in the Sierra foothills, half of them Indians: this would soon change. In 1849 alone more than 40,000 people made it overland to California from the Eastern U.S., 6,000 Sonorans had traveled north from the Mexican borderlands, and by the end of the year 697 ships had arrived at San Francisco, bringing another 41,000 argonauts (Holliday, 1981: 297). In 1850, another 50,000 came overland, and 35,000 came by sea (Ibid, 397). Despite as many as 31,000 disappointed miners leaving California so as to return home in a single year (1853), the state's population grew to 380,000 by 1860, and 560,000 by 1870, not counting Indians, who were being decimated by the Anglo-American newcomers.

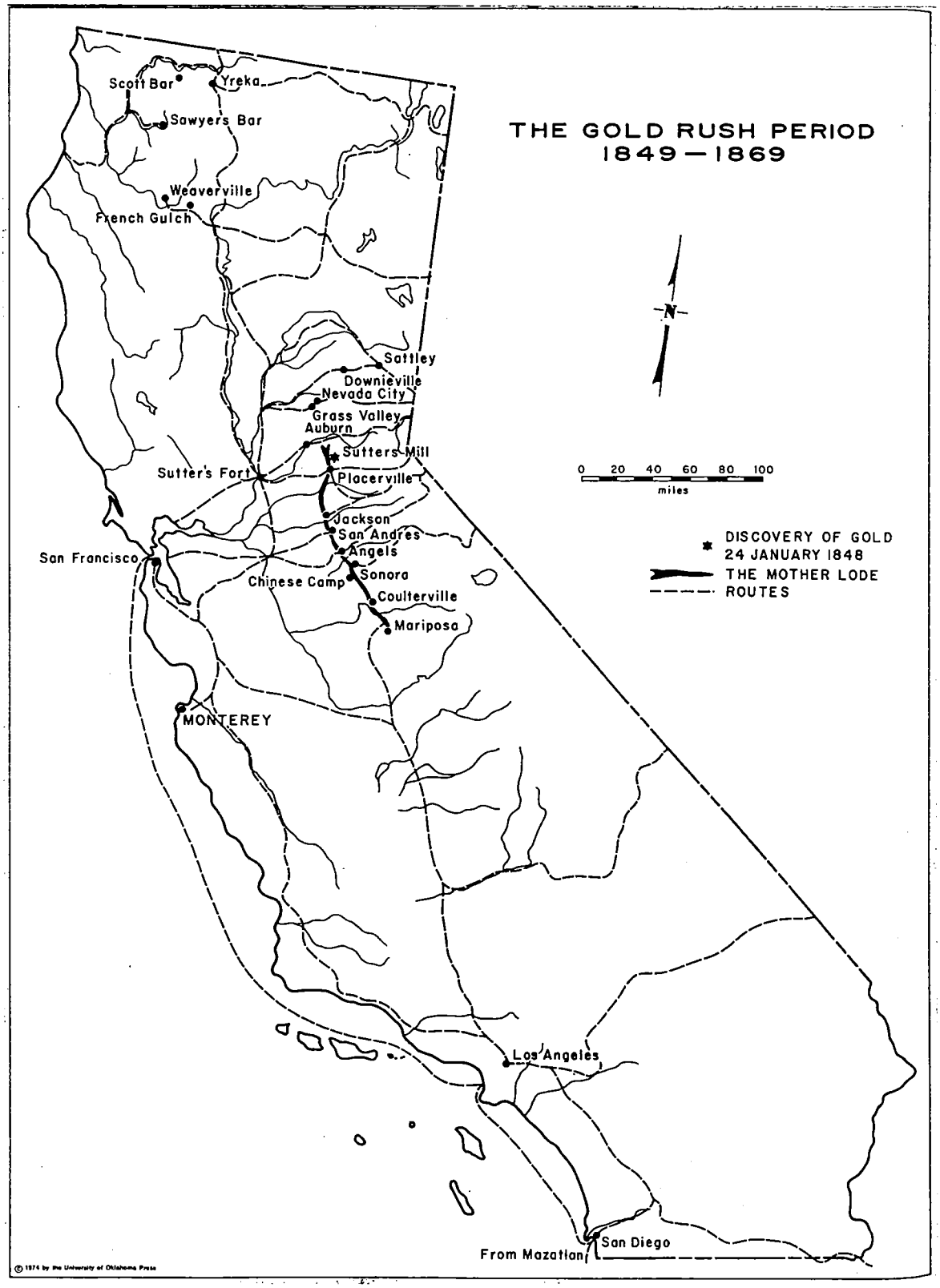


Figure 1: Cities, towns, and mining camps of Gold Rush California, reproduced from Beck and Haase, 1974: Map 50.

California came to be known as the great *El Dorado*, after the popular New World legend of the "gilded man". As early as 1539, Spanish *Conquistadores* were told of a South American Indian king so rich that he oiled his body every day then covered himself in gold dust, which was removed through a daily ritual swim across a sacred lake. The search for the lake of El Dorado motivated gold exploration across the length and breadth of Spanish America, and resulted in the draining of Lake Guatavita in the interior of Colombia via a hand-dug canal in the late 16th century, and the reported recovery of a fortune in gold (Bray, 1979). El Dorado had been a byword for treasure-seekers throughout the Americas since the early 16th century, and the gold fields of California were quickly christened a new *El Dorado* by Spanish-speaking miners shortly after the discovery of gold in early 1848.

In the first ten years of the Gold Rush, California produced approximately 600 million dollars worth of gold. The value of this treasure in terms of present-day American currency is almost incalculable; some idea of its worth can be judged by comparison with common salaries and costs of the period on the East Coast; privates in the U.S. Army were paid around ten dollars a month, a good horse could be bought for $40.00, and a good meal for ten to twenty-five cents. The California Gold Rush turned the world upside-down, and the California of 1849 or 1850 presented an appearance scarcely imaginable today. Hundreds of tent cities or towns with scores of wooden buildings dotting the landscape in areas that have subsequently had virtually no resident human population. Angel's Camp had a larger population than Los Angeles. Hundreds of sailing ships worth millions of dollars lay abandoned in the mud of San Francisco Bay because their crews had deserted and rushed off to the mines. Prospectors bought horses at many times their normal price, then turned them loose once they reached the gold fields because the time spent feeding them could be more profitably spent panning gold, and one simply bought another horse when one needed it. So few people were left to perform menial tasks such as washing clothes that laundry was sent from the gold fields to San Francisco, then by ship to Honolulu, where at least some laundrymen unaffected by gold fever could be persuaded to wash clothes instead of boarding ship for the new *El Dorado*, and then sent back by boat to California, taking two months or more round-trip.

Gold was what made California uniquely attractive in the mid-19th century, and what began the great world migration to our state which remains unabated today. With the Gold Rush being the single most significant event of California history, surviving gold rush sites and artifacts constitute, without question, historical archaeological evidence of the greatest potential importance. Precisely because so much of what was then gold rush California is now valuable timberland, foresters should have a familiarity with basic gold extraction and processing techniques of the 1840's, '50's and '60's, for it was these past technologies that left the most lasting trace upon the landscape prior to the advent of modern logging in California.

PLACER MINING

The earliest gold extraction in California was done with penknives and crowbars, as miners prowled the creekbeds looking for gold veins in the exposed bedrock. Within a few weeks, with thousands of miners on the prowl, such easy pickings were exhausted, and gold extraction was then accomplished through placer mining. Placer mining was hardly mining at all, but simply the separation of gold grains, which, once dry, became gold dust, from the silty, sandy or gravelly matrix

THE CRADLE AND MANNER OF USING IT.

Figure 2: The gold rocker or "cradle" being used by Chinese miners. Note sterile gravel being discarded from perforated tray or sifter at upper left, water being ladled over matrix at lower right. Reproduced from Hutching's California Magazine, *Vol. 5, No. 3, September, 1860.*

in which it was naturally admixed through alluvial deposition. Placer gold extraction was achieved through manual panning, rocking, or sluicing. *Placer* is a Spanish term for sand-bank, sand-bar or alluvial deposit; in an obvious play on words, it is also the Spanish term for "pleasure"- this early form of gold-getting was indeed pleasurable in comparison to the back-breaking and dangerous work of hard-rock tunnelling, ore-hauling and mechanical ore-stamping that continued for many decades after the initial "rush".

The technology of California placer mining was simple, and imported essentially wholesale from the gold and silver mines of Sonora, Peru and Chile by Latino miners, then subsequently improved by Yankee mechanics, carpenters and blacksmiths. Gold panning, the simplest method, simply involved separating out the heavier gold grains from the lighter sand or silt matrix by converting the gold-bearing matrix into a slurry through the addition of water, and then by swirling the non-gold matrix bit by bit over the lip of the pan, leaving the heavy gold dust and nuggets in the bottom of the pan. Panning for gold was quite labor-intensive in terms of the yield, and only could process comparatively small amounts of "pay dirt"; Averill (1949: 19) estimates that at the very most, less than a cubic yard of sediment could be panned per miner, per day; a miner who could wash 50 pans of sand or gravel in a day was doing very well indeed. This notwithstanding, most prospecting (i.e.; testing the productivity of a new claim) was still done with the gold pan right up to the 1930's, rather than with any more elaborate technology. If the claim was found to have gold-rich soil through panning, then the rockers, long toms, or other more elaborate processing method was then brought in to work the deposit more efficiently.

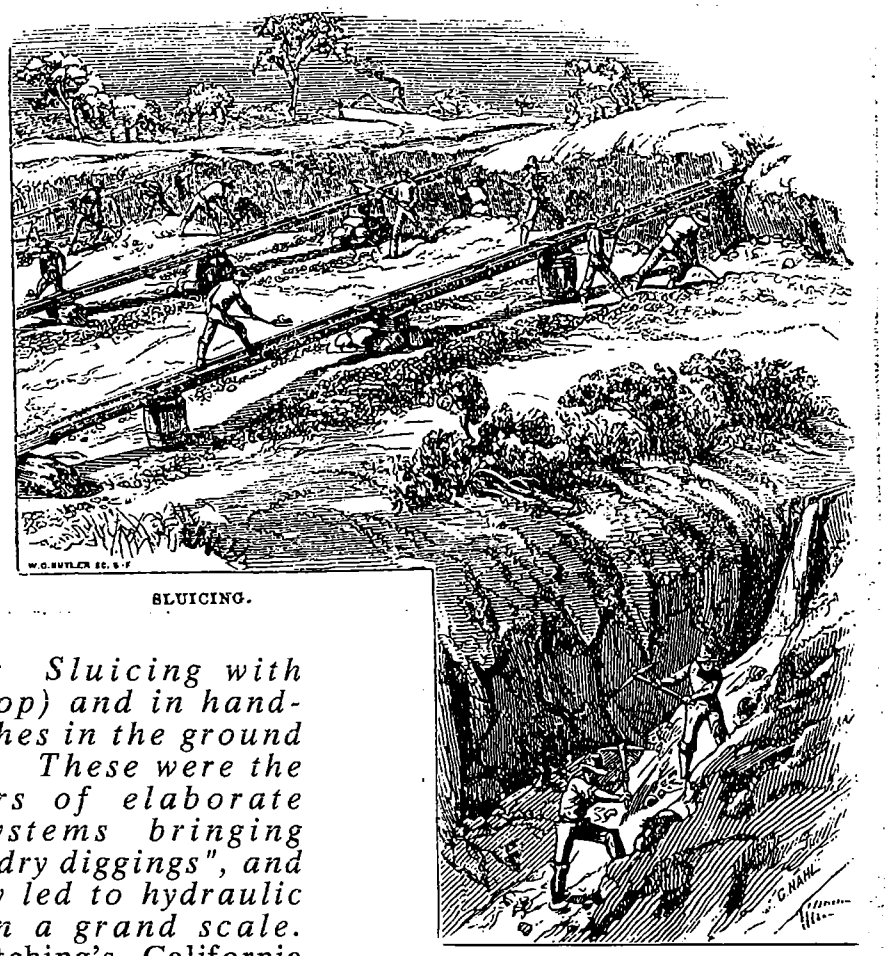
The first gold pans were not pans at all, but shallow Indian baskets which were found to be too fragile to withstand the daily abuse of the miners. For a while, however, the Indian baskets used in gold panning were in great demand, and their price rose to $15.00 apiece (Caughey, 1948: 25). Sonorans used the wooden pan

Figure 3: A "long tom" in use near Auburn in 1852: note woman at center in bonnet with lunch basket. California State Library photo.

or *batea*, which could be carved out of local oak, but the gringo miners wanted something more durable. Consequently, blacksmiths began experimenting with riveted pans, the eventually came up with the standard gold pan, with flat bottom, low, outflaring sides, and a reinforced rim. Eventually, a stamped-iron pan some 18 inches in diameter and 3 inches deep became standard. Soon, such gold pans were being mass-produced all over the country, and argonauts commonly bought them before arriving in California (Hutchings, 1860).

The first gold rocker (or "cradle") in California was made on March 9, 1848, at Coloma, by Isaac Humphrey, an ex-miner from Georgia who knew the business of gold extraction from first-hand experience (Cutter, 1949: 16). Soon, thousands of such rockers (Figure 2) would be in use in the California gold fields, made through imitation, and improved through trial and error (Hutchings, 1860). The gold rocker was simply a box with a single or multiple screens in the form of insertable trays through which gold-bearing soil was sifted, usually with the aid of water which was either ladled or bucketed in (Johnson, 1974: 92-93).

The screens separated out the larger gravel chunks which could be visually inspected for the presence of nuggets, and then discarded by the expedient of simply taking the screen out and dumping it upside-down. The smaller silt, sand,



SLUICING.

GROUND SLUICING.

Figure 4: Sluicing with flumes (top) and in hand-dug trenches in the ground (bottom). These were the harbingers of elaborate flume systems bringing water to "dry diggings", and eventually led to hydraulic mining on a grand scale. From Hutching's California Magazine, *Vol.5, No.3, September, 1860.*

and gold particles fell through the screen(s) towards the bottom of the rocker, where a slight incline led towards an exit chute. The heavier gold particles sank either to a trap in the rocker's bottom, or were kept from running out along with the sterile, slurried, matrix by low battens nailed perpendicular to the sloping baseboard of the rocker above the exit chute. The standard kind of screen or sieve was simply a sheet of metal with hundreds of nail holes punched through it. Abandoned ships in San Francisco harbor had their copper hull sheathing stripped off for conversion to rocker gratings.

The box rested on curved members much as those of a rocking chair or infant's rocking cradle; so as to encourage sifting, and the downwards passage of the heavy gold fraction, the box was simply rocked back and forth on its curved skids by use of either a vertical handle or by simply repeatedly stepping on the end of one of the skids (foot-pumping). Like the use of the gold pan, the rocker was essentially a one-man processing method, and the rocker could be broken down and transported from place to place with little difficulty. Unlike panning gold, a much higher volume of gold-bearing sand, gravel, or dirt could be processed, several cubic yards per day depending on the availability of water and the size of the matrix grains.

MEN ENGAGED IN WORKING OUT THE RIVER'S BED AFTER TURNING THE STREAM INTO THE FLUME.

Figure 5: River Mining in the Sierra Nevada foothills in the 1850's. Miners have built a curving rock and earthen dam held in place by a plank retaining wall reinforced with vertical posts; the water thus dammed is diverted into a large flue or plank-lined canal at left. The dry bed of the river (foreground) is being worked with the aid of a long tom (bottom), and large boulders are being removed through use of a block and tackle and swing-boom. From Hutching's California Magazine, *Vol. 2, No. 3, September, 1857.*

"Long toms" (Figure 3) were used in Appalachian mines as early as 1809, and were probably first introduced to California by an ex-miner from Georgia. These were similar to rockers in that the gold-bearing gravel was shoveled into them and the matrix was washed with water. The long tom, however, had a heavy sheet iron grate or mesh at its top that kept the large rocks from going through as the gold-bearing gravels were shoveled into them; this grating partially covered an open-ended sluice box around a dozen feet in length, made of wooden planking with battens or riffle bars nailed to its bottoms. Running water was channeled into the head of the long toms so that water was always running trough them, and then gold-bearing dirt and gravel was shoveled into the trough in quantity, and finally passing through a second screen at its lower end (Johnson, 1974: 92-93).

As with panning and the rocker method, the light fraction washed away down the sluice and back into river or watercourse downstream, but the heavier gold flakes were trapped behind the riffle bars. After an adequate amount of dirt had been sluiced, a trapdoor in the bottom of the long tom, upslope from the riffle bars, was opened, allowing the running water to be diverted out of it and the gold to be picked out of its bottom without fear of it being carried away. The Long Tom, unlike the rocker, was stationary and its construction and use required a large

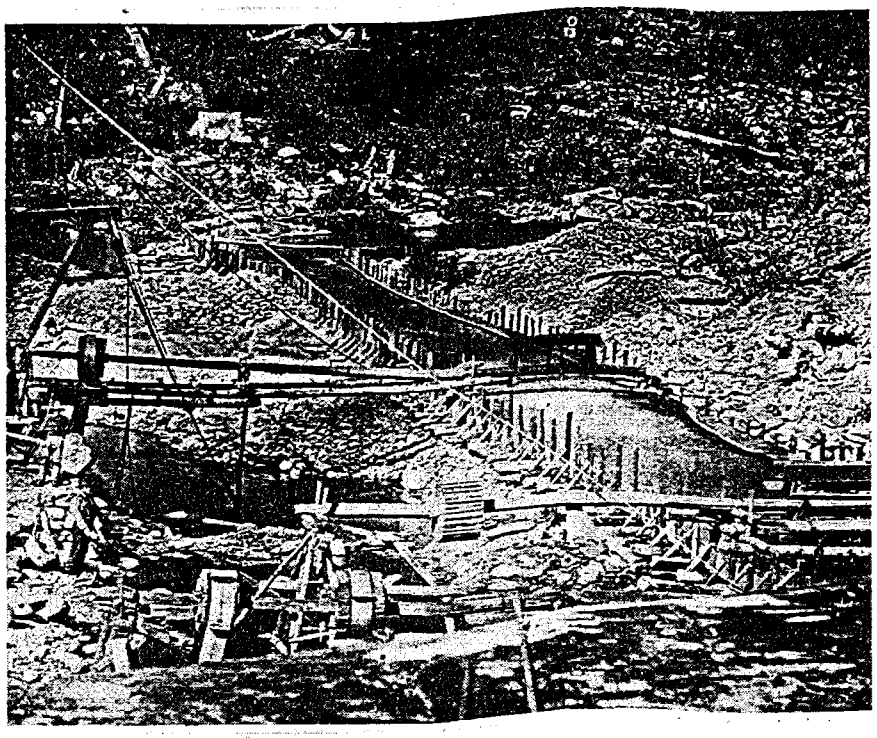


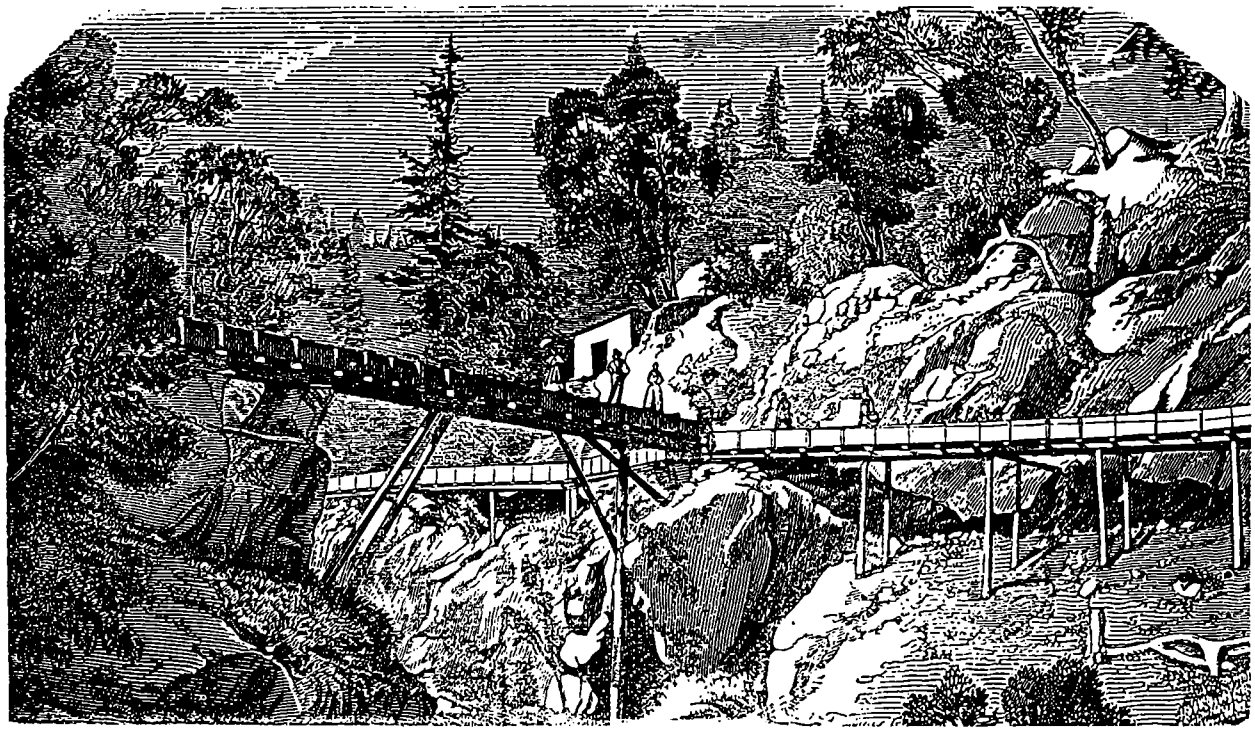
Figure 6: Mining the bed of the Cosumnes River near Grizzly Flats, El Dorado County, in 1850. Bancroft Library photo, reproduced from Browning, 1991: 71.

investment of labor to build as well as constant maintenance. Eventually very long sluice boxes were tried, some of these 50 or 60 feet long. Most such sluices were the results of cooperative effort or of the formation of miner's companies or associations. A well-functioning sluice, however, served by half a dozen to a dozen miners, could process tons of pay-dirt every day and was the best means of getting the gold out when a particularly rich placer deposit was found (Hutchings, 1860).

FLUMES, DITCHES AND HYDRAULIC MINING

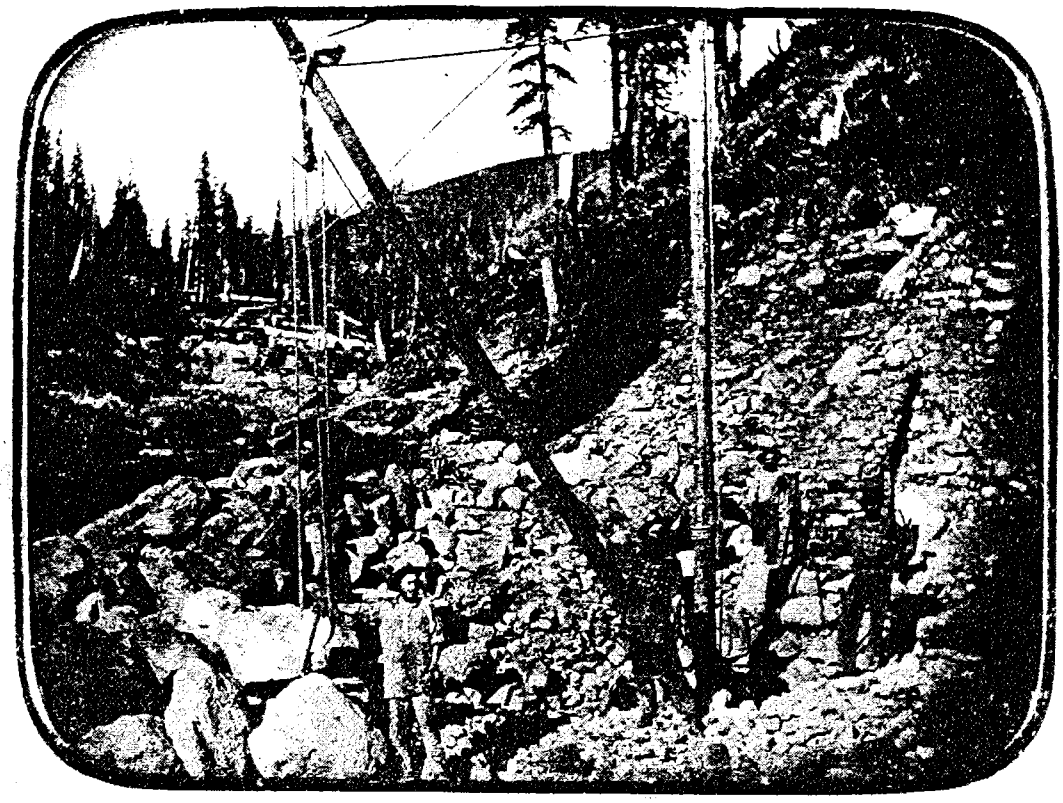
Water was brought to "dry diggings" by ditches, flumes and other waterworks, oftentimes many miles in length, so that gold-rich deposits with no locally available source of water could be worked (Figure 4). The most ambitious kind of placer mining involved hydraulic engineering efforts of grand scope undertaken so as to exploit alluvial deposits too deep for surface working. Creeks, streams, and even rivers had their courses diverted so that their beds could be exposed for gold-hunting (Figure 5). The water was channeled either through hand-dug alternative courses or directed into wooden flumes. Such river diversion could only take place at the height of summer, usually between July and September, when the Sierran streams were at their lowest (Hutchings, 1857a).

A fascinating series of photographs (Figure 6), taken during the late summer of 1850, shows one of these operations near Grizzly Flat, on the Cosumnes River in El Dorado County: the entire river has been channeled into a plank-lined canal upslope from its original bed, and the water thus flowing turns a number of belt lifts powered by paddle wheels. The lifts descend to the old bed of the river, where miners excavate the deep pockets of gold-bearing gravel just above the



FLUMING IN A CANON.

Figure 7 (Above): Elaborate, elevated mining flume in the Sierra Nevada, used to carry water to the placer workings at "dry diggings" and/or for hydraulic mining. Reproduced from Hutching's California Magazine, *Vol. 5, No. 3, September, 1860. Figure 8 (Below): Mining ditch construction in the Sierra Nevada, 1850: the block and tackle is being used to remove boulders from the course laid out for the ditch. Bancroft Library daguerreotype, reproduced from Holliday, 1981: 374.*



bedrock, and shovel it into the lifts, which raise it and drop it into the ends of long toms and sluices for separation.

Hundreds of miles of wooden flumes (Figure 7) and hundreds of Long Toms were in use throughout the California gold fields by the early 1850's, and their construction led to the demand for millions of board-feet of planking. Most of the lumber that went into their construction was cut locally, and whipsawed into planks by the arduous sawpit method; later, local sawmills in the Sierra Nevada produced rough planks for flume and Long Tom construction, most of these powered by overshot waterwheels at the ends of flumes themselves.

Jackson (1970: 225) notes that:

> "A survey of the mining region made in 1858 shows, in the northern mines, some 1500 miles of ditches and flumes constructed, in the central mines 2175 miles, and in the southern mines (roughly from Mokelumne Hill to Mariposa) 796 miles of earth moved, rock blasted, and boxes built to carry the all-important water. Altogether 731 companies or more loosely organized groups had been formed to carry on the work. Sometimes, when a company failed, public associations or water districts were set up and funds pooled to put the job through".

Holliday (1981: 456) supplies a slightly different estimate, that by 1857 4,405 miles of aqueducts had been built in California for service to the mines, at a cost of $11,890,000.00. By 1867, some 5,328 miles of main canals had been constructed so as to facilitate hydraulic mining operations, plus an estimated 800 miles of secondary or branch ditches; the cost was estimated at $15, 575,400.00 (Logan, 1949: 31). Construction of such ditches (Figure 8) was backbreaking work, and the traces of many still remain, although no water may have flowed through them for many decades.

While the earliest ditches were constructed so as to facilitate placer mining, they led to the invention of hydraulic mining around 1852 or 53, in which great water cannons or monitors directed streams of water under high pressure against poorly consolidated but gold-rich sediments. Once these sediments had been washed down by the water cannons (Figure 9), their gold could be extracted through sluicing or some other secondary method. Hydraulic mining was first tried near Nevada City by a miner named Edward M. Matteson, but did not catch on as a standard practice until the more easily worked placers had been picked over.

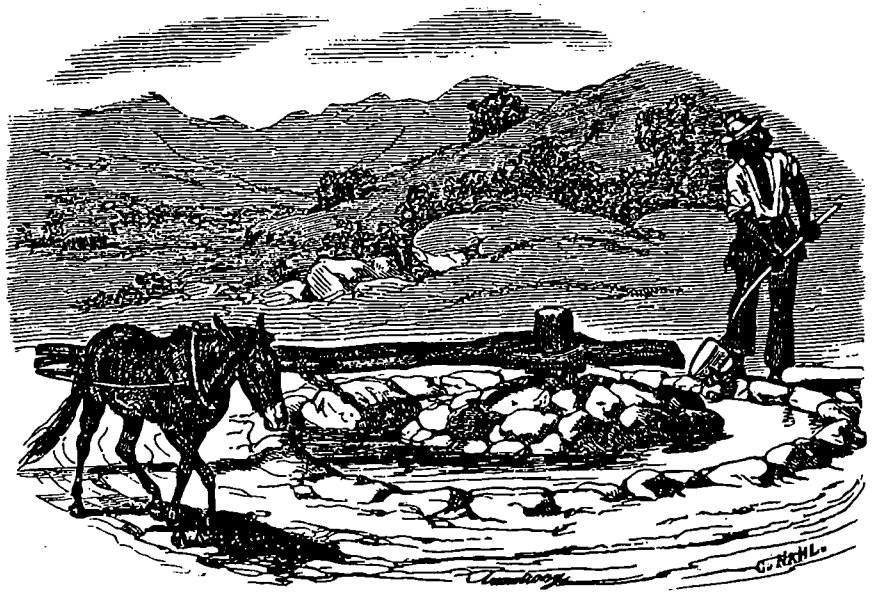
The monitors or water cannons were fed by ditches leading into wooden flumes which finally led into either canvas hoses or riveted iron pipes; the pipe kept stepping down in diameter until at the nozzle the water pressure was tremendous. The smaller monitors shot a stream of water 4 to 5 inches in diameter; the largest, 9 inches (Averill, 1949: 19). The most powerful monitors could reach more than 200 feet with a sustained stream of water; it was said that if the water accidentally hit a miner it would kill him. By the 1880's hydraulic mining had devastated so much of the Sierra Nevada foothills and led to the siltation of so many streams and rivers that the surface area of San Francisco Bay was estimated to have been decreased by 30%, and the clogging of the major rivers was inhibiting steamboat traffic. Hydraulic mining was stopped by court order in 1883 due to pressure from Central Valley farmers whose fields were being alternately flooded or water-starved, or covered with silt and detritus washed down from the diggings.

Figure 9: Hydraulic mining in action, Nevada County, 1866: four small monitors at work on a single gravel bank. Library of Congress photo.

HARD ROCK MINING

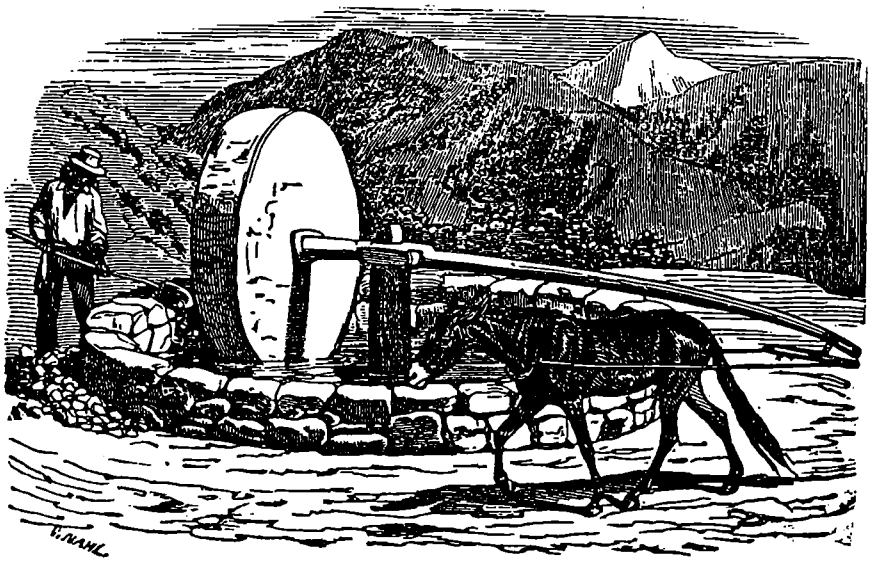
Eventually, the placer deposits were completely worked over, and the loose gold in the form of nuggets or flakes was no longer turning up through placer extraction. Now, in order to continue extracting gold, the metal had to be traced to quartz veins running through granites and other rocks, and this meant actual mining and crushing the quartz so as to release the gold (Logan, 1949). Quartz, or hard rock, mining came to predominate by the late 1850's, especially after the Comstock silver strike of 1859 (Browne, 1961).

The earliest, and simplest, quartz crushing mills were of the *arrastra* (Figure 10), or Sonoran, type: simply a large boulder or pair of boulders chained to a horizontal, rotating beam. The boulders were dragged in an endless circle while the beam pivoted around a vertical axle post. The beam was powered by mule, ox or even human power, and the gold-rich quartz was shoveled in and crushed by the weight of the stones. The crushing floor was either set up directly over bedrock or, more commonly, over a *patio* of flat flagstones. The sterile crushed quartz was then removed, and the gold-rich matrix remaining was then amalgamated with quicksilver, derived from the substantial mines at New Almaden near San Jose, smelted and cast into ingots. When the amalgamation was done without removing the crushed ore from the arrastra, low masonry walls were built in circular fashion around the *patio* floor to keep the precious gold-quicksilver mixture from escaping (Hutchings, 1857b). These circular features are still commonly encountered in the Mother Lode country (Heizer and Fenenga, 1949).



THE MEXICAN RASTRA.

Figure 10 (Above): One-mule-powered Sonoran arrastra *used for crushing gold-bearing quartz in the mid-1850's; note heavy boulder chained to beam. Figure 11 (Below): Chilean one-mule-power quartz crushing mill of the mid 1850's. The heavy rotating millstone crushed the gold-bearing quartz, and the retaining wall kept the quicksilver used in the amalgamation process from escaping. Both reproduced from* Hutching's California Magazine, *Vol. 2, No. 4, October, 1857.*



THE CHILI MILL.

FEEDING THE MILL.

Figure 12: Crushing gold-bearing quartz through the use of a ten-stamp mill. The drawing is simplified for clarity and somewhat incomplete. The vertical stamp bars are lifted by the cam (shown "floating" in space, not connected either to its drive belt or its bearings), and the ore normally was washed through with the use of water supplied by a flume (missing). Reproduced from Hutching's California Magazine, *Vol. 2, No. 4, October, 1857.*

An improvement over the Sonoran *arrastra* with dragged boulder was the rolling or *Chile Mill* (Figure 11). Instead of boulders being chained to the rotating beam, a large, heavy, circular millstone rolled over the patio floor, crushing the quartz: this millstone had a central perforation that fitted over the opposite end of the beam from that to which the ox or mule was hitched, the beam serving as a true axle for the millstone. The *Chile Mill* was much more efficient than the Sonoran *arrastra*, for it used much less motive power to reduce a similar amount of gold-bearing quartz.

With the inevitable entry of high-finance in hard rock mining, a third and much more advanced form of quartz processing was introduced; the iron stamp-mill (Figure 12). The first stamp mill operating in California went into service in July, 1849, in Mariposa County. Such stamp mills were very expensive and had to be forged in large ironworks; many came from the Donohue Brother's Union Ironworks in San Francisco (R. Dillon, 1984), the first to be erected anywhere on the Pacific Coast of North, Central or South America. By 1852 some 108 stamp mills were in operation in California, having cost nearly 6 million dollars to build and operate; 90% of them failed, either due to transportation problems in getting the ore to the stamper, or because they were erected over comparatively poor deposits (Caughey, 1948: 256). By the late 1870's, some mines had mills with up to 50 individual stamps, but the average size was much smaller. A typical case was that of the Woodside Mine, of Georgetown, El Dorado County. First exploited in the 1850's and 1860's, the mine was closed because it was too expensive to work. The mine was reopened in the 1870's and shares totaling some $40,000 sold, and a 5-stamp ore mill installed. Profits, however, totalled only $3,000.00, barely enough to pay off outstanding debts, leaving nothing for the miners' salaries or for the investors (Davis and Rambeau, 1987: 54).

The earliest stamp mills were made of wood, with the bearing and crushing surfaces shod with iron "shoes". Later on, they were made of cast or forged iron; later still, of hardened steel. A horizontal cam with eccentric lobes or "lifters" was turned continuously, usually by an overshot waterwheel but later, in some places, by steam donkey engines. A series of heavy vertical iron bars were set in a frame parallel to the cam; these bars rested atop a heavy anvil plate of iron, their bottom or striking ends also faced with hardened iron. Each bar had a perpendicular projection that was aligned with one of the lobes on the cam. As the cam turned, the lobes pressed up against these projections, lifted the vertical bars, then dropped them suddenly onto the anvil or striking platform below. An inclined chute led down to the striking platform on one side and down away from it on the opposite; gold-bearing quartz was fed into the upper chute and gravity fed under the stamps, then flushed down the exit chute for subsequent amalgamation and smelting.

CONCLUSION

Concomitant with hard rock mining a new interest in lumbering developed. Deep mine shafts consumed immense amounts of timber for braces and supports, and the steam donkey engines that turned the giant wheels lifting ore to the surface or which pumped constantly encroaching water out of the shafts burned tons of fuelwood on a daily basis. This demand for lumber led not only to the first tree-cutting in the forested parts of the gold-fields but to the development of timber resources in parts of California without any appreciable gold themselves, such as the Santa Cruz Mountains and the north coast ranges of Mendocino, Humboldt, and Del Norte Counties. Eventually, the profits from gold dwindled while those from logging grew, until today throughout much of California's old "gold country", logging is the leading industry, and has been for many years.

Unfortunately, logging goals and methods have not always been compatible with the preservation of such evidence. Gold rush camps and towns, once so numerous in forested settings, have been bulldozed into oblivion again and again, with only traces left behind to attract the attention of the bottle collectors or historical archaeologists. Today, most gold rush sites have been damaged to a greater or lesser extent whereas many have been completely restored. Before this window on the most important period of our past history is closed forever, we need to take steps to preserve what is left, not only for our own benefit, but for the generations to come as well.

A case has been made for the importance of sites and artifacts dating to California's gold rush period, and the common distribution of such historic evidence through much California timberland has been noted. Need every mining ditch, tailheap, or can dump be preserved, often to the detriment of present-day logging objectives? The answer is of course not. Archaeological preservation should not be viewed as an obstruction to logging interests but as a necessary by-product of modern timber harvesting that is completely compatible with modern logging goals and expectations. The criteria for archaeological significance (age, uniqueness, and state of preservation), apply to historic sites and resources no less than to prehistoric ones, and should be used to guide the forester in deciding what should or should not be preserved, and in what quantity. A five-stamp quartz mill or stretch of narrow-gauge ore-cart track with rails remaining should be preserved and avoided. A five-mile stretch of mining ditch filled in and converted to haul road should not. In closing, that which is old, unique and intact should be preserved; that which is common and compromised, might not.

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Timberland Historical Archaeology Notes 3:

A Brief History of Logging in California

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Archaeological Training Program for
Registered Professional Foresters

INTRODUCTION

Long before California was recognized as a place of great mineral or agricultural wealth, it was appreciated as a source of tall, straight, timber. Timber harvesting in one form or another has taken place in California more-or-less continuously for the past 10,000 years, since the earliest arrival of human beings within what we now call the Golden State. Such lumbering was casual at first, but increased in complexity as the chronological clock ran closer to the present day. The story of the California lumber industry is that of the entire lumber industry in the New World, for every major innovation in lumbering technology to appear on the Pacific Coast of North, Central and South American took place in California first. California innovations routinely came to be practiced in Canada only after a lag of 20 years or so; they established themselves in Latin America in some cases after more than a half-century had gone by. Conversely, California lumbermen were constantly on the lookout for new technologies developed in other parts of the world, and were quick to adapt new ideas to their own local logging efforts.

Modern California logging technology is as sophisticated as that of any other great industry in the western United States. Timber is harvested with a variety of specialized machines designed to cut and remove logs with great speed and a minimum of waste. Present-day sawmills are computer-driven and laser-guided; both in the field or at the mill, technological changes have been so significant within the past 50 years as to render earlier kinds of timber harvesting and processing almost unintelligible. Yet, this modern technology was built upon the solid foundation of the older logging methods, and would not exist today were it not for the trial and error of past lumbermen. Some 19th century California logging methods are long extinct, doomed by the more advanced technology which replaced them, others are still with us, albeit often in different form. Each such previous logging method left its traces on the California landscape, and may be identifiable from remnants specific to it alone. The present paper is offered as a review of California's past logging methods so that Foresters will be aware of the kinds of tangible evidence which still remains in our forests and which might be encountered in future Timber Harvest Plans.

PREHISTORIC TIMBER HARVESTING

Whereas California Indians did occasionally fell trees, ethnographic descriptions of such activities are virtually nonexistent. Lorenzo, a Costanoan Indian born at Santa Cruz Mission in 1819 (Heizer, 1974: 77-81; Williams, 1892) recalled that his own father's "tribe ...lived up the coast . . .[and that] They made their huts of branches of trees, which they cut down by firing and then using sharp stones". Lorenzo's father's *rancheria*, was probably north of Santa Cruz in the Davenport area.

Lorenzo's father could have been born as late as 1800, or considerably earlier; in any case, regardless of whether the events described took place in the Prehistoric or Early Historic period, the technology described is without question prehistoric, and appears to be the only account of aboriginal-style Costanoan timber-cutting (W.J. Wallace, personal communication). Even after the establishment of the California Missions, it is likely that access to scarce, Spanish, "metal-age" tools such as saws and axes was restricted only to neophytes under the supervision of *Gente de Razon* (non-Indians), and that Indians engaged in lumbering for

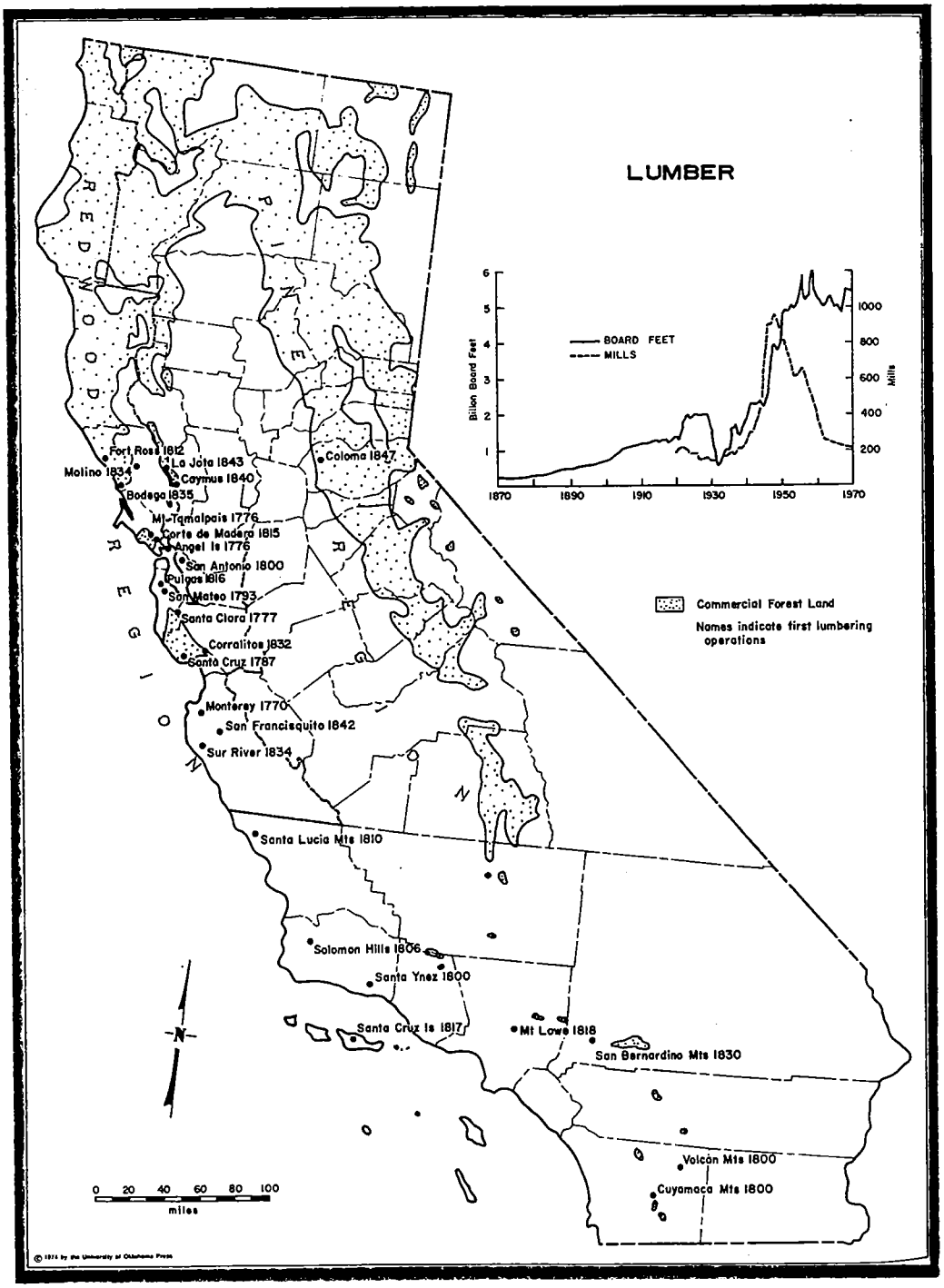


Figure 1: Development of the lumber industry in Spanish/Mexican California, 1770-1847. From Beck and Haase (1974: Map 98).

their own purposes probably would have relied upon stone age or prehistoric technology well into the Spanish Colonial period.

The prehistoric Costanoan Indians who cut wood in the Santa Cruz Mountains probably did so along the lines familiar to archaeologists and ethnographers from far northern California, where Indians never subjected to missionization survived as master woodworkers into the present century. One is struck by both the sim-

plicity of the technology and by the patience of the people employing it. Most California Indians seldom intentionally felled entire trees, having no specialized tools with which to do so. Instead, the state's earliest human residents tended to use the wood from natural deadfalls and blowdowns in interior areas, or scavenged drift logs in riverine or coastal regions. In prehistoric California, the greatest demand for wood was as fuel, not as a building material for houses, and most if not all firewood was scavenged from the earliest time of human arrival. I am unaware of any written reference to California Indians ever having intentionally cut down trees specifically for fuel wood. Certainly, they pulled down widowmakers and snags, pushed over potential blowdowns, and collected windfalls everywhere within what is now our state. The same methods of firewood collection also probably served to supply the vast majority of wood employed in constructive pursuits, which, in any case, called for limbs or trunks neither thick in diameter or tall in height.

For Northern California Indian architectural constructions, (Powers, 1877) the beaches and rocky coastlines were "combed" for suitable logs after violent winter storms, and riverbanks, snags, and, especially sandbars at curves or hairpins in the larger drainages were scouted for wooden treasure after spring floods in the prehistoric period. In the infrequent situation in which living trees were intentionally felled by prehistoric Californians, this was normally done by girdling. Girdling was accomplished by either chipping or bludgeoning a narrow, circumferential ring of the tree's bark and cambium layer away with one-handed stone tools, or by burning it off with red-hot coals held by tongs, between dampening gaskets of wet mud slapped on the trunk so as to diminish the danger of accidental fire.

Carefully-controlled fire was by far the most effective prehistoric tool employed, and trees were felled with the same precision that the California Indians burned and scraped their dugout canoes in the northern 1/3 of the state. While controlled burning as a woodworking method has been dead in California for perhaps 200 years, South and Central American Indians still make use of it in order to manufacture dugout canoes. Two Kekchi Maya Indian brothers, both friends and associates of the past 15 years, were raised by the last professional Indian dugout canoe maker in their part of Guatemala. Into the 1960's, he felled trees and made dugout canoes from single tree-trunks. The felling process, even aided by steel axes, took several weeks, the hollowing process, aided by steel adzes and chisels, still took six months to a year per tree.

In prehistoric California, as throughout ancient North, Central, and South America, the "necklace" of charred wood produced by controlled burning around the living tree's trunk was then chipped or sliced out of the burned zone with brittle stone tools, creating a circumferential groove down to the unburned hard wood. Then, the process was repeated, the groove deepened through repetitions of burning, chipping and slicing almost ad infinitum. Cutting trees this way took the form of "weekend projects" rather than concerted efforts which were prosecuted until completion during a single episode. Consequently, a single tree might be girdled over a period of months or years of intermittent effort, the selected tree coming down long after the need for it had been originally expressed.

"Trimming and limbing" was also virtually unknown as an intentional process in ancient California; one reason why drift logs were preferred to intentionally cut trunks by the Indians is that after some weeks or months of being tossed in the surf or against rocky headlands, naturally fallen trunks were available in very clean form (i.e., debarked, and with most branches snapped off). In the few cases

where prehistoric lumberjacks intentionally felled trees in California, it is presumed that branches were burned off by building small fires and then carefully controlling them immediately adjacent to the trunk in the original position of its fall.

As arduous as the intentional felling of trees must have been in aboriginal California, this was probably easy in comparison to the transportation of the trunks themselves. Relying entirely upon human muscle power, the California Indians were limited in their tree-felling by not only the size of the trunk to eventually be transported, but by the distance to the final wood-consuming area. With these factors in mind, it seems obvious that virtually all California Indian tree-harvesting was directed towards comparatively small trees very close to the settlements or villages at which they would be employed, for whatever reason.

North of San Francisco Bay, Indians split logs with antler wedges driven into the grain by stone mauls; the planks that were split off were smoothed with small hand-adzes with stone or even mussel shell bits and finished with natural "sandpaper" made of sharkskin (Kroeber, 1925). Semi-subterranean plank houses were thus constructed, and were characteristic of northwestern California at the time of initial European contact. Similar wedges excavated in archaeological contexts (i.e., Lillard, Heizer and Fenenga, 1939) in the San Joaquin/Sacramento delta region indirectly suggest that plank-making and perhaps plank-house residence enjoyed some popularity within a wider region of ancient California, only to die out by the time the earliest Europeans arrived. Similarly, specialized prehistoric wood-working tools such as beaver-incisor chisels were known from a variety of contexts in prehistoric central and northern California, but did not survive into the Historic Period.

SPANISH COLONIAL PERIOD LUMBERING

A more sophisticated lumber operation first began in California in 1770 at Monterey, under the Aegis of the Europeans. The Spanish Colonial lumber industry still was little changed from that employed by the Romans in their province of Iberia. In California, the "Botany Bay" of New Spain, lumber productions was different from the Indian tradition mainly in that it employed metal cutting tools and animal power as a motive force (Foster, 1962). Spanish Colonial tree-cutters, carpenters, and cabinet makers began making intrusions into the forests around Monterey Bay, cutting trees, making lumber from them, and converting that lumber into house-beams, tool parts, and boats, employing axes, adzes and hand saws, all of iron, imported from Central Mexico (Burgess, 1962; Brown, 1966; Clar, 1957; 1971; Beck and Haase, 1988).

Clar (1959: 13-14) notes that the whipsaws produced in Spain's Colonies were only four feet long, so that consequently, only very small-diameter trees could be cut. Later, larger saws with lengths up to 7 feet were surreptitiously purchased from Yankee or English traders, and correspondingly thicker and taller trees could be cut. At no time in either Spanish Colonial or Mexican Republican California was there a capability of forging either steel axes or crosscut saws; all such tools had to be imported at great cost from great distances.

In early historic California, planks were made from felled trees where they lay, occasionally by splitting with wedges, but more commonly through use of a two-man saw and sawpit, or *serrucho braguero* (Figure 2). This process is still in use throughout forested parts of Latin America, and I have seen it in action many

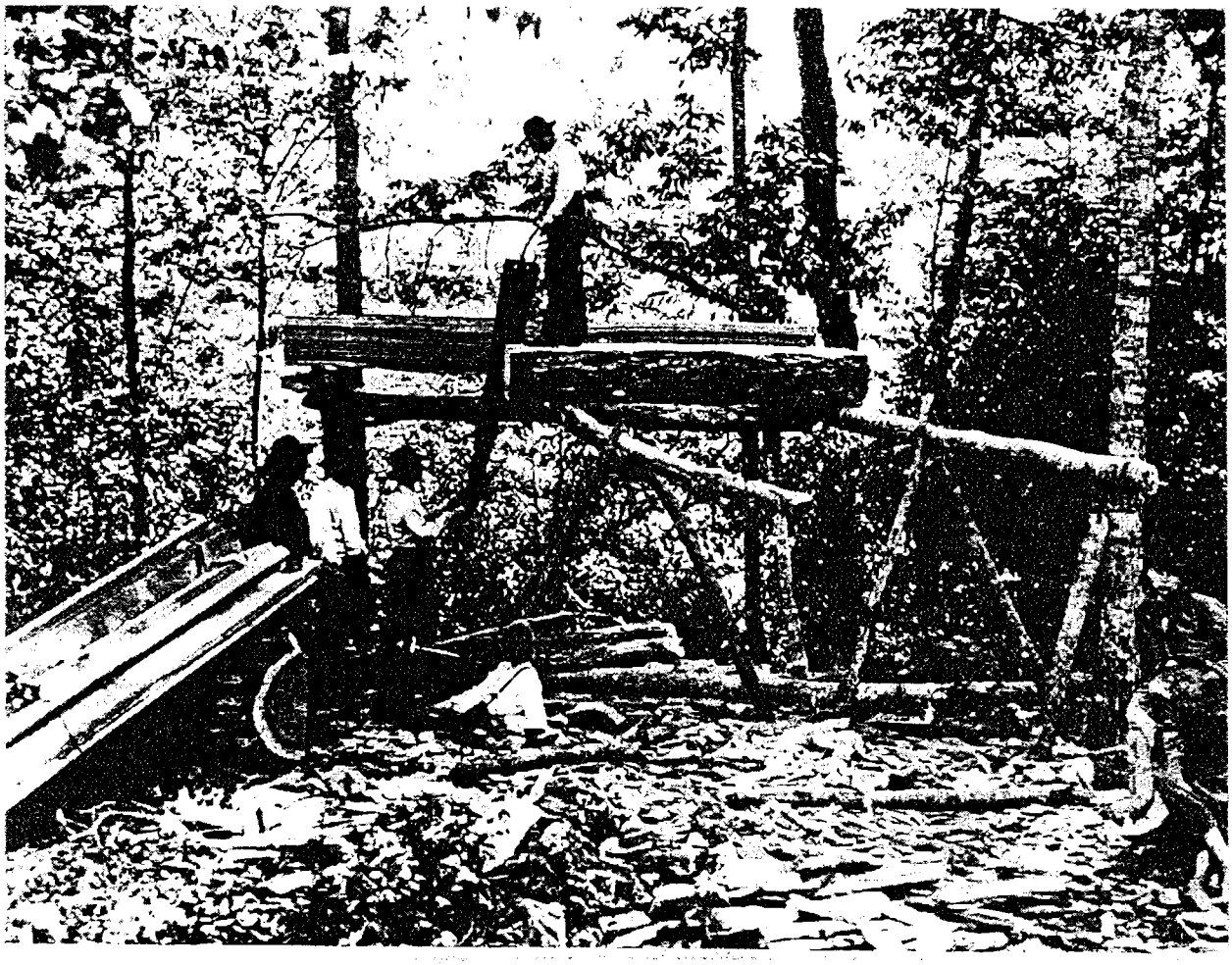


Figure 2: Whipsawing planks from a log raised on elevated trestle, late 19th century. The Spanish and Mexican sawpit method with serrucho braguero *was similar. U.S. Forest Service photo, reproduced from Andrews, 1957: 44.*

times. The felled tree is levered up from the ground bit by bit and supported by rocks or short cut log lengths until it is a few feet off the ground. Then, it is either braced or a semi-permanent trestle is built under both ends if on flat ground, or under the "downhill" end if on sloping terrain. Next, a small pit is dug to the depth of a man's height under the trunk, and the sawing process begins.

One sawyer, the "topman" (the senior, or chief) stands atop the trunk, pulling the two-man saw up, the other, the "pitman", or junior sawyer, is consigned to the pit beneath the log and pulls the saw down for each cutting stroke. The junior sawyer's job is one of the most hazardous and unpleasant ever devised by man. If the heavy log slips from, or breaks its trestle, it can maim or kill the lower sawyer; the lower sawyer also is constantly having only slightly less heavy planks fall on him; and even at the best of times, all the sawdust from the cut being made falls on him, blinding and partially asphyxiating him. As is well understood by anyone who has ever worked with redwood, the sawdust produced from this species is especially obnoxious; the same acids in the wood that ensure its comparative immunity to bug infestation also render it extremely harmful to eyes and mucous membranes. We will never know how many people in the Spanish Colonial

sawpits, probably most of them neophyte Indians, were crushed, went blind, or developed lung disease from pulling the saw.

Owing to the generally small size of the whipsaws in use during the Spanish Colonial and Mexican periods (probably around 2 varas, or roughly 6 feet in length) it is more than likely that only comparatively small trees were cut. It was not until the coming of the Yankees that the great whipsaws measuring 10 to 12 feet in length were available to fell the largest trees (McCrary, personal communication). Despite the back-breaking labor involved in Spanish Colonial lumber production, pine lumber from Monterey was shipped as far away as San Diego as late as the 1780's. The first recorded use of California Redwood was in 1776, when Mission Dolores and the Presidio at San Francisco were partially built of this material. The Coast Range mountains and foothills were already familiar as valuable timber lands to the Spanish Colonial authorities before the founding of Santa Cruz mission, and the first recorded lumbering operation in what would later become Santa Cruz County began in 1787.

A hundred years later, sawpits or elevated sawing frames were still being used in California to make planks in out-of-the-way places too far from stationary sawmills for cut lumber to be economically carted in. After the Gold Rush and California statehood, a new kind of saw appeared, the *pit frame saw*, with narrow blade tensioned within a wooden frame, unlike the old pitsaw which was broad at the upper or cutting end, and gradually tapered towards the nose or pulling end. The pitsaw had wide, two-handed, dowel handles perpendicular to the long axis of the blade: a good crew with a good saw could cut up to 200 linear feet of lumber per day (Andrews, 1957: 44).

The Russian settlement at Fort Ross, on the Sonoma County Coast, was ostensibly a trading and fur trapping entrepot rather than a lumber establishment, but some of the first redwoods cut north of San Francisco Bay were felled by Russian, not Spanish, speakers. As early as 1812, when the colony was founded, local timber was being axe-felled and hand-sawed into planks for the construction of the fort itself, and associated structures. Eventually, the Russians even built sailing vessels out of local lumber, and exported some planking north to their settlements in Russian Alaska. But, apart from the immediate vicinity of the Fort itself, the Russian influence on the development of the California lumber industry was negligible.

Some of the earliest use of forest products from the Coast Ranges was the harvesting of bark from Tanbark Oak (Jepson, 1911) by Indians under the direction of the Mission fathers for use in hide preparation. Certainly until approximately 1830, California's most profitable export was cured hides, many of which were more or less smuggled to cobblers in New England, and which provided the raw material that helped this area develop as a manufacturing center.

Sections of bark up to a couple of feet long were "peeled" off tanbark oak trunks and limbs; a vertical cut joined an upper and lower circumferential cut so that a hollow "tube" of bark could be pried away from the heartwood beneath. McCrary (1981: 29) remembers how this was done by members of his family as late as the 1930's, with an axe and peeling bar or "spud". Small trees were "peeled" as far up their trunks as a man could reach; larger trees were felled, and the bark peeled off in four-foot lengths.

In most cases, "peeling" an oak killed it, but resulted in a source of future hardwood fuel. The tanbark was normally "peeled" in spring or at the beginning of

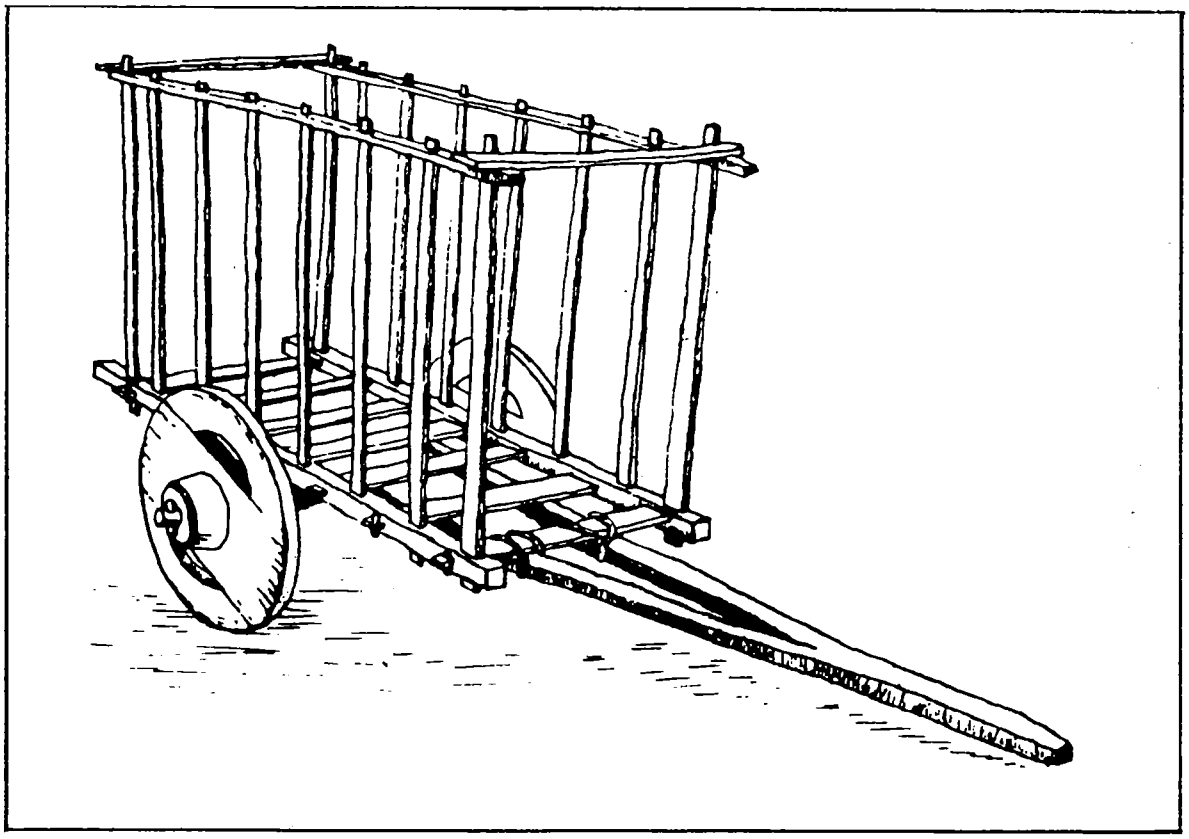


Figure 3: A Spanish Colonial carreta or ox-drawn cart. Reproduced from West and Augelli, 1966: 302.

summer so that it could be stacked in a sunny spot near the tree that produced it and left to dry (greatly reducing its weight) for periods of time up to a full year. When the lengths of bark had curled inwards from their vertical cut ends, forming a kind of double-volute reminiscent of the capitals of Ionic columns, they were adjudged dry enough and could be packed down to the tannery for chipping and eventually, for hide processing.

San Francisco and some of the East Bay cities were important tanning centers from the 1850's through the 1890's, shipping cured hides and finished leather goods all over the west coast and back east to even larger markets. The tanning industry of Santa Cruz itself "boomed" even before statehood in 1850, with the first non-Mission tannery built in Scott's Valley in 1843. Santa Cruz became one of the primary tanning centers of California, in large measure because of the quantity of tanbark oak trees in the Santa Cruz Mountains. By the late 1860's 300 tons of tanbark were being consumed each month; by 1870 no fewer than ten tanneries were operating in Santa Cruz County (Gordon, 1987: 73). The decline of the tanning industry by the end of World War I is thought to be at least in part the result of having killed an estimated 75% of all the tanbark oaks in the Santa Cruz Mountains by "peeling" their bark. The situation was similar to the north and to the south in the Coast Ranges.

While tanning with chemicals replaced the old tanbark method in most cases by 1920's, the demand for tanbark continued in specialty applications. As late as the 1940's (McCrary, personal communication) tanbark was still being harvested

commercially in small quantities in the Santa Cruz Mountains for specialty leather production. In this final chapter of California's oldest commercial industry, the leather cured in this old-fashioned, "natural" way was almost exclusively used for the "cowboy" market; fancy saddles, tack, gun holsters, etc.

Slowly at first, then gradually faster and faster, the production of finished lumber began to challenge the importance of the tanbark industry in the Spanish Colonial California. Lumber produced at the California missions was being shipped as far as Lima, Peru by 1813, and by 1816 the rich stands of timber in coastal California were attracting Russian, English and American loggers who were "poaching" the trees owned by Colonial Spain. Clar (1959) summarizes Spanish Colonial edicts and correspondence indicating concern over the Indian custom of setting fires so as to make clearings which would attract game animals; the authorities were afraid that such practice, if not stopped, would diminish valuable timber resources. Clar (ibid) also notes the earliest fire-fighting organization in California, directed by Spanish Colonial soldiers from the Monterey Presidio and manned by neophyte Indians from the local missions who cut firebreaks with axes.

In Spanish Colonial California much of the tanbark moved from the forested mountains to the missions on the backs of Indian neophytes, only when trails existed could it be transported by packmules. As lumber production became increasingly more important, the "bottleneck" in the process soon became recognized as transportation, or the problems inherent therein. No large "freight" type wagons existed for the transportation of cut logs, planks or timbers over any distance; only two-wheeled, single-axle, high-wheeled, *carreta* or ox-cart of Spanish and Mexican California (Figure 3) was available. The *carreta* was the all-purpose means of "heavy transport" in early historic California, "heavy" meaning any weight over that which could not be put in a rawhide bag and lashed to a saddlehorn. Such two-wheeled *carretas* for most of the history of Spanish and Mexican California were the only wheeled vehicles of any kind, and similar in most respects to *carretas* still in service in Honduras, Nicaragua, and Costa Rica which I have ridden in, and, upon occasion, even loaded with lumber and other building materials.

The limitations imposed on Spanish and Mexican period lumbering by shortcomings in transportation may have been abetted by the standard Californio cultural bias against the carreta, which smacked of slow-speed and Indian servitude. In pre-Anglo-American California, amongst the *Gente de Razon* ("people of reason", i.e.: non-Indians) only infants and sick or aged individuals would deign to ride in wagons (carretas), the proper mode of conveyance and badge of personal pride being the (male or female, juvenile or adult) individual's proficiency at reckless horsemanship. Since California Indians were prohibited by law from owning or riding horses, but were encouraged to drive and maintain ox-carts, no self-respecting non-Indian would be caught dead personally involved with the loading, movement, or unloading of a carreta.

The carreta's high, solid wood wheels were designed to pass over the continuous ruts and to "bridge" the depths of the numerous "V-shaped" stream crossings of pre-statehood California with light loads rather than to bear heavy weights. Usually, no more than at most a pair of oxen was hitched to a carreta; their pulling power was usually equal to the demands of the load, and any additional animals would have probably resulted in catastrophe, oxen being normally intractable and hard to control if faced with impediments (i.e, the hindquarters of other, stalled, oxen) in front of them.

Nevertheless, Spanish-Mexican carretas were doubtless employed in the earliest logging industry in California, no other wheeled vehicles having been available. One presumes that cut planks or splitstuff were stacked in them and lashed to their "stake-bed" configuration. If cut logs were transported with their agency, it is likely that one end of the log was lashed to their bed, the other dragging in the dirt of the "camino", or road. Obviously, the "roads" of Spanish and Mexican California even when of "royal" dimensions barely ten or twelve feet wide, twice the width of the wheelbase of a single carreta, would not have allowed for the transport via carreta of logs of any great length. McCrary (1981: 6) notes that whipsawed lumber was traded at the exchange rate of 250 board feet per cow.

Spanish and Mexican Period skid roads in early historic California were few and far between, usually at best simple mud tracks as they remain today throughout backwoods Latin America. Where the natural grade did not assist the downward passage of individual logs or where arterial skid roads all came together into a "timber thoroughfare", unlike later skid roads, they were never "corduroyed" or surfaced with short cut lengths of log so as to keep the logs headed downhill from hanging up in potholes, or on roots. As simple a product as forged iron chain, taken for granted by the Yankees to the east, was virtually nonexistent in Spanish and Mexican California. Without it, logs could not be linked together so as to be hauled out by large ox-teams; this limited Spanish-Mexican hand logging to a "one tree at a time" basis. Before the California Gold Rush, what logging chain in California there was was of generally poor quality, and most of it had to be imported at great expense either from Central Mexico or came in "illegally" via Yankee trading ships.

The easiest kind of logging to do on an individual basis was production of "splitstuff", and most early Spanish Colonial and Mexican period lumbering apart from tanbark harvesting in the Coast Ranges was probably devoted to this practice. The coast redwood is the preferred tree species for splitstuff in the Coast Range, owing to its very straight grain and comparatively small branches (which produce few, and small, knotholes). Nevertheless, only at best 1 tree in a hundred might be suitable for the production of splitstuff (McCrary, personal communication).

In order to determine whether or not a specific tree is suitable for splitstuff and should be felled, local loggers early on began "chipping" potential candidates. "Chipping" the tree simply involves taking a chunk out of the trunk with an axe or saw, cutting through the bark and cambium layer into the grain so that its straightness and quality can be seen. Only the most likely candidates for splitstuff would be "chipped", and only a small percentage of these would actually be felled.

MEXICAN PERIOD LUMBERING

The first water-powered sawmill in California was built at San Gabriel Mission in 1824, but served no commercial purpose, only being employed so as to supply the needs of the Mission and not the nearby town of Los Angeles. Far to the north, on the Columbia River in what would later become the Oregon Country, a second water-powered sawmill was built by the British in 1827 at the behest of the Hudson's Bay Company. Within the next decade, however, two more water-powered sawmills would begin operation in what would later become Sonoma and Marin Counties, both serving mammon, not God. In 1834, Juan Bautista Rogers Cooper built a water-powered mill on the Russian River so as to cut redwoods near what today is Forestville; he called his establishment, not surprisingly,

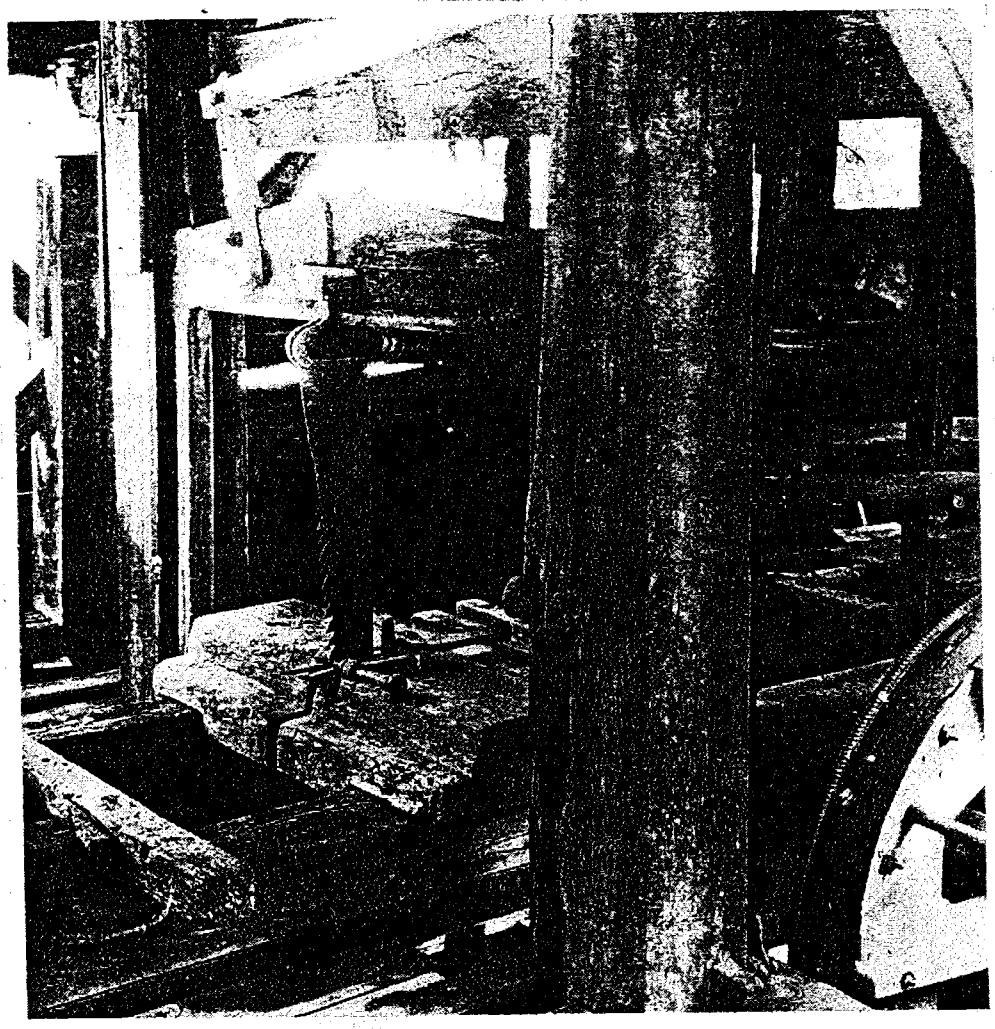


Figure 4: Vertical or "sash" type water-powered sawmill of early type: this is the Deter Sawmill in Siskiyou County. U.S. Forest Service photo, reproduced from Andrews, 1957: 20).

Rancho El Molino (Mill Ranch). Also in 1834, John Reed, yet another of the Irish sailors who seem to have been so omnipresent in Mexican California, was granted the *Rancho Corte de Madera del Presidio* ("where wood is cut for the fort") on the lower slopes of Mount Tamalpais in what is now Marin County. Reed built his sawmill in what is now Mill Valley. Like Cooper, Reed selected the location because of the size and proximity of local redwood groves (Hoover, et. al., 1990: 177; 481).

By 1845 at least half a dozen water-powered sawmills were in operation within Alta California. These early mills did not employ circular saw blades but vertical or "sash" type blades in frames that rose and fell as the logs were pushed through them (Figure 4). Sometimes, parallel blades were placed within the frame so as to cut finished beams or multiple planks. One of the last such sash-bladed sawmills was the Deter Mill, built in Siskiyou County in 1881, long after the Mexican period and after most mills used circular saw blades. The Deter Mill was built of hand-hewn lumber, the beams locked together with mortise joints and wooden pins; the pulleys and gears were also made of wood. The water-powered Deter sawmill produced up to 30,000 board-feet of lumber a day and ran until 1898, and much of its lumber went into the construction of Yreka (Andrews, 1957: 20).

The Monterey Bay area continued to witness innovations in the development of forest products; the earliest use of split-shingles used to roof a house in California, for example, were employed by William Hartnell at Monterey in 1827 (Clar, 1959: 21). Over time this material came to be seen as an alternative to thatch or tiles. Thomas O. Larkin, the American Consul at Monterey during the Mexican period, was also a local merchant and entrepeneur, and developed the lumber trade around the Monterey Bay area by providing credit to independent lumbermen and by selling their lumber. By 1834 Larkin had his own teams of whipsawyers, mostly gringos who had jumped ship, working for him in various parts of the Coast Range (Clar, 1959: 21-22; Williams. 1976: 39). Larkin paid $40.00 U.S. per 1,000 board feet of lumber to his terrestrial timber pirates, shipping much of it down to Santa Barbara and Los Angeles on his small bark the *Don Quixote*. By the early 1830's timber "poaching" by foreigners, especially by Isaac Graham and his followers in the Santa Cruz Mountains, had become such a problem that the Mexican government of California imposed a tax on lumber for the first time, and prohibited the exportation of lumber from California. Recognizing legitimate demands, however, the Mexican governor allowed, nonetheless, the captains of foreign vessels in California waters to cut and use all timber necessary for essential repairs to their ships.

Just as the Spanish Colonials were the first to create fire-fighting crews to protect the California forests, so were the Mexican authorities the first to propose the first comprehensive timber conservation plan for California (Hittell, 1885: 365). In 1839, the Minister of the Interior of the Mexican Government officially called attention to the disastrous effects of sustained years of drought in northern Mexico (which, of course, included California). Minister Romero perceptively noted that deforestation was a well-known cause of drought on the local level, and so as to safeguard water resources for agriculture and stockraising, he proposed that limits on the timber cutting then proceeding in unrestricted fashion be enforced, and that replanting of trees in cut-over areas should begin. Unfortunately, no such actions were formally approved by the Mexican government, which had other concerns, such as protecting her northern territories against the yankees who were in the process of stealing them (Clar, 1959).

Notwithstanding the prohibition against exporting lumber from Mexican California, by the early 1840's planks, doors, window frames and other finished wood products were being shipped in greater and greater quantities down the coast from Monterey to Santa Barbara and Los Angeles (legal), down to Mexico, Central America, and Peru (quasi-legal) and across the Pacific to the growing missionary establishments in the Hawaiian Islands, and back to the Yankee states on the east coast of North America (illegal). The redwood stands of the Santa Cruz mountains and North Coast Ranges of what would later become Marin and Sonoma Counties experienced their first major cutting during this period, as the wood was correctly recognized as bug and disease resistant, and therefore superior to the more common pine. As late as the Gold Rush period, newly arrived Anglo-Americans marveled at the immense size, straight grain, and durability of what was still being called "red cedar" or "Spanish cedar".

Rafael Castro, one of the most energetic of that large Californio family, before the Mexican War was also an early pioneer lumberman, cutting redwood trees on his Rancho Aptos and nearby in the Santa Cruz Mountains. Castro had the felled trees sawed up into planks, and sold the lumber locally and to the increasing numbers of Yankee traders who were beginning to visit the Monterey Bay area. Castro probably was not anywhere as abusive of the Mexican timber regulations as were his gringo neighbors, being related as he was by blood or by marriage to

Figure 5: Peter Lassen, builder of the first sawmill in the Santa Cruz Mountains, 1841. From Hutchings' California Magazine, September, 1859.

PETER LASSEN.
From a Photograph by R. H. Vance.

most of the Mexican governmental officials, and encouraged by family courtesy if not by force of law to conform to the spirit of the regulations at best feebly enforced in the Coast Ranges.

Sometime between 1821 and 1823, William ("Bill the Sawyer") or, more appropriately, *Serruchero* Smith arrived in the Santa Cruz Mountains in what is now San Mateo County, and went to work supplying the growing town of San Jose with redwood beams, planks, and poles. Smith, a Yankee sailor, had jumped ship at San Francisco in 1818. The area where the lumbering was done came to be called *Canada del Corte de Madera* (or wood cutter's canyon) just as the similar town of Corte Madera in Marin County was identified only as the place where firewood and lumber was produced at an earlier time. Within a decade, "Sawyer" Smith was joined in the Santa Cruz Mountains by another English-speaker interested in the timber industry, John Coppinger (Clar, 1959).

John Coppinger (or Copinger) was an Irishman, an ex-junior British Naval officer, who came to the Santa Cruz Mountains in 1832. Marrying into a local Mexican family, he began a small lumber concern, whipsawing redwood in the valley which would eventually be granted to him as the *Rancho Canada de Raymundo* (present-day Woodside) in what is now San Mateo County. Copinger commanded the artillery detachment that helped Juan Bautista Alvarado become Governor of California during his coup of 1836, and doubtless followed the career of his neighbor and fellow adventurer Isaac Graham (ibid; Hoover, et. al, 1990: 376).

Isaac Graham is normally credited with building the first water-powered sawmill of any kind in the Santa Cruz Mountains; he is said in 1841 or 1842 to have constructed a small, water-powered mill seven miles north of Santa Cruz at the

confluence of Bean and Zayante creeks (Payne, 1978: 55; Clark, 1986: 138-138; Verardo & Verardo, 1987: 95; Hoover, et. al, 1990). Graham, born in Virginia in 1800, was the youngest of an even dozen children. Arriving in California in 1833, after spending time as a hunter and trapper in Kentucky and Tennessee, Graham was a troublesome Yankee in the Monterey Bay area who had his hands in various illegal or quasi-legal ventures (Nunis, 1967; Payne, 1978: 53-54; Clark, 1986: 138-139). Bringing from Kentucky a fondness for, and a facility in producing, distilled spirits, Graham soon became known as "the man to see" for illicit liquor in the Santa Cruz area. After deportation and imprisonment in Mexico, Graham returned to Santa Cruz, and settled on the *Rancho Zayante* (later the site of the town of Felton). Graham needed the mill as a means of economical production of barrel staves so that he could make whiskey casks in furtherance of his first great love, moonshining.

However, "Graham's" Rancho Zayante sawmill was actually built by Peter Lassen (Figure 5), and whose idea it was in the first place remains unclear. Lassen, famous for the county named after him on the California-Nevada border, was a Danish "mechanic" and blacksmith. He is said by Clar (1959: 36) to have been paid 100 mules in cash-poor Mexican California in exchange for building "Graham's" Mill. *Hutchings' California Magazine* of exactly one hundred years earlier (September, 1859) however, states that

> "In the spring of 1841, he [Lassen] purchased half a league of land near Santa Cruz, where he built a saw mill, which was the first one ever built and put into successful operation in the country. . . After cutting from forty to fifty thousand feet of lumber, he sold out his mill and ranch to Capt. Graham-who still resides there-taking one hundred mules for his pay, intending to return with them to the United States. . . (ibid: 387).

So, much as was the case with his contemporary Sutter, whose sawmill was not so much his creation as that of his employee John Marshall (R. Dillon, 1967), in Santa Cruz County, Peter Lassen may have done the work while Isaac Graham got the credit. At just about the same time, 1843, Pierre (or Pedro) Sansevain (B. Dillon, 1989) petitioned the Mexican Government for permission to build another sawmill near Santa Cruz, and whether or not he actually did build it, was nonetheless cutting timber that year with official governmental sanction. Sansevain's uncle, Jean Louis Vignes, a cooper, carpenter, vintner, and sawmill builder, had settled in Monterey as early as 1831 before moving on to San Diego and finally, to Los Angeles and San Bernardino, where he more or less "invented" the California wine industry on the scale for which it is today famous.

Sansevain's interest in lumber and milling would probably have been for the purposes of cooperage, as both he and his uncle recognized that the principal limitation on wine production in California was not availability of the grape, but the lack of storage casks within which to ferment the squeezings. In this regard, it is useful to again remember Sansevain's neighbor, Isaac Graham's fame as a distiller, and his probable need for similar casks for a different kind of product. In fact, Payne (1978: 53-54) states that in 1838 "Pedro Somsevain" (surely Sansevain?) was working for Isaac Graham as a whipsawyer, which is possible, but somewhat improbable, as Sansevain may not have arrived in California until the following year, and certainly would have worked for either his uncle, Vignes, who brought him to Mexican California, or for his brother, Jean Louis Sansevain, at 22 only a year older than Pierre or "Pedro" (B. Dillon, 1989).

In trouble again by 1844, Graham gained notoriety as the most flagrant violator of Mexican logging regulations and non-payer of governmental lumber production taxes. Later the same year, Sansevain protested the demand of the government that 5% of the value of the lumber he was producing be paid, and was ordered to answer directly to the governor. After his directorial debut in the development of mechanization in the California lumber industry, Graham later was a principal (or at least newsworthy) participant in the Bear Flat Revolt of 1846, having of course already practiced for the event and been rewarded for it at Mexican Government expense an even decade earlier. Graham finally died in 1863, and one wonders if the entire state did not breath easier for the event.

If the Santa Cruz Mountains were perhaps the focus of the most intensive lumbering in Spanish and Mexican California, the North Coast Ranges were by no means overlooked. We have already noted the establishment of sawmills on the Russian River and the lower slopes of Mount Tamalpais in the 1830's; the single most significant technological advance in Mexican Period lumbering would also take place in the North Coast Ranges. The first steam-powered sawmill in California, or, for that matter, on the entire Pacific Coast of North, Central or South America, was built at Bodega Bay, in the southernmost corner of what would later come to be known as Sonoma County. Just as the now-departed Russians had utilized the valuable the timber resources of the Sonoma coastal strip, now a new arrival began to cut the abundant redwoods growing near the abandoned Russian establishment at Fort Ross. The Pacific Coast's first steam-powered sawmill was erected in 1843 by Steven Smith. Smith was a sea captain, originally from Baltimore, who became a naturalized Mexican citizen, settling in California with a 16-year old Peruvian wife. To power his mill, Smith brought a small boiler and simple steam engine "around the horn" with him from Maryland in his ship the *George and Henry* (Clar, 1959: 38-39; Hoover, et. al, 1990: 481). Captain Smith built his mill of redwood timbers cut via the ancient sawpit method in the Santa Cruz Mountains and loaded aboard his ship at Santa Cruz. The following year, the Mexican Government granted the immense, 8-square league (35,000 acre) *Rancho Bodega* to Smith, and gave him its blessing in furtherance of his redwood-cutting ambitions. While Smith's sawmill was the portent of things to come, water-powered sawmills continued to be built in California into the 1880, s and in fact, the last water-powered sawmill on the west coast was built as late as 1903 near Prince Rupert in British Columbia. This remarkable throwback to the past is still operating today (Gould, 1975: 39).

At the same time that Captain Smith was getting his sawmill established, the old Russian timber holdings on the Sonoma Coast excited the interest of one of the most colorful characters in California history, John Sutter. His attempts to establish a foothold in the redwood country of the North Coast Ranges formally rebuffed by the Mexican authorities, Sutter turned instead to the sugar pine forests of the Sierra Nevada so as to develop his infant lumber business, and the result became the stuff of legend. Captain John A. Sutter (R. Dillon, 1967) was a Swiss who came to California in 1839 via Santa Fe, Fort Vancouver, and Honolulu. Sutter had abandoned his wife and children and was one step ahead of a European debtor's prison, but in only five years became the single most important colonist of California's Central Valley and the Mexican governor's right-hand man. Sutter set out to carve out his own empire in the California interior, aided by a cosmopolitan group that would presage the modern California mixture; Yankees, Hawaiians, New Mexicans, Californios and Indians. By 1840 he had established his camp on the American River at its confluence with the Sacramento and was exploring other Sierran streams such as the Cosumnes, sometimes in the course of punitive raids against hostile Indians.

In 1844 or 1845 Captain Sutter sent timber cutters out from his settlement at New Helvetia far beyond the limits of his Mexican land grant into the foothills of what would become Amador County. A logging camp was begun at a place named Pine Woods, thought to have existed some five miles east of present day Sutter Creek. This was the first permanent establishment of any kind built by non-Indians in the Sierra Nevada. Sutter planned to sell milled lumber for commercial profit both in New Helvetia, and to ship it downriver to Yerba Buena for export. Presumably at first the logs were felled and then they were to be floated downriver where they would be whipsawed into planks by the arduous old Spanish Colonial sawpit method at New Helvetia. It was found that the American River was too shallow, rocky and twisty to allow for floating logs down from the higher elevations of what would later become El Dorado County, so not only did Sutter's Mill have to be located at a different location (Coloma) but a wagon road had to be built all the way from the mill to the planned transshipment location at Sutter's Fort.

Today, the lumber industry is the leading economic mainstay of the Sierra Nevada region of California, having supplanted gold mining by the turn of the 20th century. What is not always remembered, however, is the fact that the infant lumber industry in California was directly responsible for the Gold Rush itself, for if Sutter had not begun building a sawmill in 1847, the discovery of gold would probably have come much later. After all, trappers had exhaustively explored most Sierran streams for at 20 years by 1847 on an annual basis, without ever recognizing gold. By 1847, Sutter recognized the limitations of the ancient sawpit method of lumber production, and resolved to establish one or more sawmills at the source of timber itself, then to improve a road leading from the mill back to the seat of his empire at New Helvetia. One of the carpenters and mechanics working for Sutter at New Helvetia, James W. Marshall, on July 21, 1847, left to explore the American River so as to determine the best location for Sutter's sawmill, on the advice of Samuel Kyburz, the storekeeper at Sutter's Fort.

On August 27, 1847, Sutter signed a contract with James W. Marshall to build the first of what were to be a series of sawmills in the Sierra Nevada so as to service his growing lumber business. The first sawmill (Figure 6) was to be built on the south fork of the American River in what would later come to be known as El Dorado County, instead of on Sutter Creek, which would have been closer to the source of timber but farther removed from the consuming area Sutter hoped to serve. Marshall selected a low-lying spot (at 750 feet elevation) some 45 miles east of Sacramento at a spot the Indians called Coloma, and work on the mill, a small, water-powered vertical sash-bladed affair, began. By late September, 1847, the mill was well advanced, Sutter having sent a wagonload of provisions pulled by three yokes of oxen to sustain Marshall and his crew during their carpentry and excavation efforts; he also sent six men specifically to make shingles and planking for the mill. A week later, Sutter sent a second wagonload of food and supplies, along with 40 sheep so that the labor crew could have meat "on the hoof".

By October, the thirty-mile long road between New Helvetia and Coloma was as good as any others in California, and Sutter had no fewer than five parties at work on the American River making shingles, barrel staves, and making planks for windmills and ferryboats as well as simply cutting timber. The mill was essentially completed by the end of December, 1847, and on January 24, 1848, James Marshall discovered placer gold in the tailrace of the mill and communicated this information to Sutter: Sutter tried to keep the news quiet, but it leaked out long before the mill itself was completed, in March of 1848. The Gold Rush was on

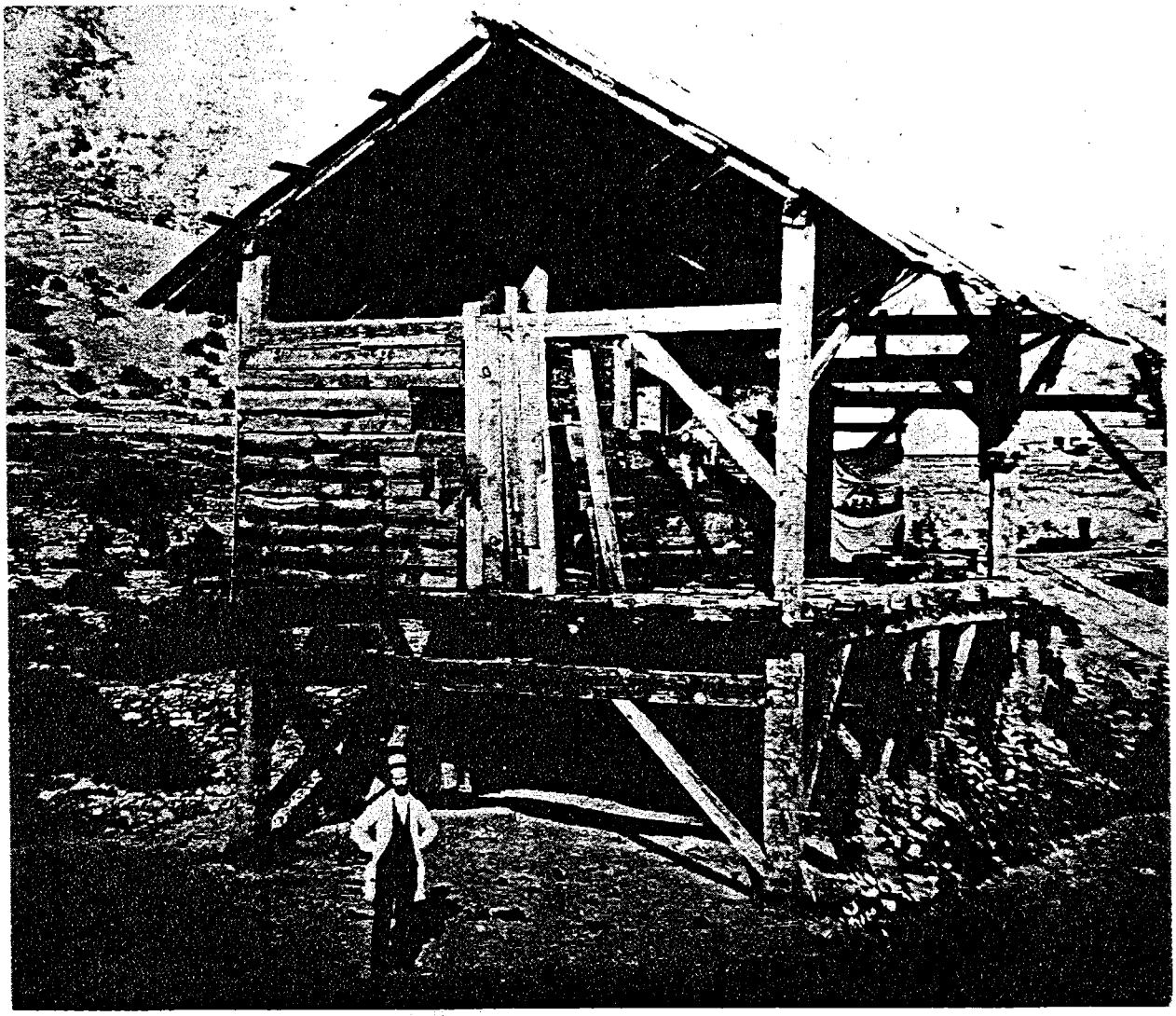


Figure 6: Sutter's Sawmill at Coloma, with James Marshall standing in front, 1852. Bancroft Library photo, from Johnson, 1974: 27.

before even the first plank had been produced at Sutter's mill. By summer, Sutter's Fort would lie almost abandoned, its residents and employees all decamped for the gold fields. Neither Sutter nor any of his associates knew that his attempt at lumbering would result in a more complete change in the character of California than that produced by the Mexican War; if gold had not been discovered, California may have remained an essentially Hispanic territory of the United States of little value or interest to the rest of the English-speaking residents of the country. Instead, California became not only a bastion of United States culture and technology on the Pacific Coast, but the magnet that attracted the Anglo-American colonization of all adjacent regions as well.

That the initial discovery of gold in 1848 that led to the "Gold Rush" of the following year was made at Sutter's sawmill is a fact known to every California schoolchild; what is not often appreciated is that the mill was a vertical-bladed affair, not one using the circular saw blade that we all tend to take for granted today. Payne (1978: 57) notes that the circular saw, seemingly so crucial an invention for any high-volume lumber milling, was invented by a Shaker woman, sister Tabitha Babbit of the Harvard, Massachusetts utopian colony, as early as 1810.

Because the Shakers invented labor-saving devices so as to have more time for prayer rather than to make money, the idea of the circular saw was confined to a very small group of essentially other-worldly people. This not withstanding, by the time of the Mexican War, the revolutionary idea of the circular saw blade was sweeping the world. The first circular saw to arrive in California was brought ashore at Monterey by the U.S. occupation troops who captured the town in 1847. This saw, so advanced in concept, was powered by a technological throwback: four mules turning a treadmill. It later was moved to San Francisco (Clar, 1959: 42). Yet another two years later, in November, 1849, Captain Steven Smith, already the most innovative lumberman of Mexican California, installed a circular saw blade at his pioneering Bodega Bay steam-powered sawmill.

ANGLO-AMERICAN LOGGING

The Gold Rush "Lumber Boom"

After the Mexican War, and especially with the arrival of the California Gold Rush, the demand for lumber skyrocketed and led to the revolutionizing of the California lumber industry. Whipsawed lumber, previously made "on commission" and traded for livestock instead of money, was now produced "on speculation" and could be sold for more than $200.00 per 1,000 board feet (McCrary, 1981: 6). All that could be made could be sold, for the demand far outpaced the supply. Of all the economic changes which concerned California lumbering between the Mexican and Anglo-American periods, the greatest was the creation of a permanent market for milled lumber; a constant demand provided by the unique requirements of California's mining industry and the boom towns it inspired.

In the gold country, tent camps and small towns, primarily of wood frame construction, sprang up wherever the gold-seekers had found "color" and at the numerous fords on rivers where the water was shallow enough to drive wagons across, and at the ferries where crossings were made via wooden flatboats. The owners and operators of private toll roads, many of them planked or "corduroyed", fords and ferries en route to the "diggins" made fortunes overnight, and were subject to little or no control. Eventually, local municipalities and county governments became involved in the improvement of roads and the building of wooden bridges: the first bridge constructed in El Dorado County, for example, was erected at Coloma in 1851 of local lumber (Hoover, et. al., 1990: 73).

> "In the first years of the Gold Rush. . .Raw lumber and red calico were the height of luxury. Out in the ravines and gulches miners often built their cabins of logs, chinked them with mud, stacked rough and ready chimneys out of the square-fracturing, slaty stone so abundant in the hills. Now and then, in some areas, the Mexican influence predominated; stores, inns and always the jails were built of adobe or of a combination of adobe and stone. There was little variety; men put their shelters together out of the materials at hand." (Jackson, 1970: 230-231).

As San Francisco, Sacramento, Stockton, and other California gold rush cities, constructed mainly of wooden buildings, grew, the demand for lumber grew with

A COTILLION PARTY OF THIRTY-TWO PERSONS DANCING ON THE STUMP OF THE MAMMOTH TREE.

Figure 7: Dancing on the polished stump of one of the Calaveras Big Trees, from Hutchings' California Magazine, Volume III, No. 9: March, 1859.

them. Adding to the demand was the fact that virtually every town in California during this early period burned down every few months and had to be rebuilt. San Francisco, for example, burned down on December 24, 1849, again on May 4, 1850, a third time on June 14, 1850, and yet a fourth time on September 17, 1850. Each time the city was rebuilt, more of the structures were made of brick or masonry, much of which had come around the horn as ballast in the holds of the sailing vessels now stuck in the mud offshore. By the end of 1850, more than 7 miles of street had been planked over, and hundreds of wooden frame structures were built and rebuilt each time they burned down.

In 1849 and 1850 (Harris, 1960: 122), so few skilled lumbermen were working in California that finished planks were often imported to California from the East Coast in true "coals to Newcastle" fashion. Nevertheless, such imported lumber sold for $1.00 per board-foot on the dock at San Francisco. Jackson (1970: 84) notes that near Auburn at the same time milled lumber sold for $1.50 per square foot. With finished lumber commanding such prices, it didn't take long for some miners who went broke in the diggings, especially lumbermen from Maine and Georgia, to go "prospecting" for another money-making resource such as timber. As early as 1849, some found that they could make more money cutting and selling lumber than in panning gold. The uplands of the "Gold Rush" Counties in the Sierra Nevada were logical places for this new industry to develop, particularly because of the world-wide fame of the Calaveras Big Trees. The forest giants, first seen by Zenas Leonard before the Gold Rush, were popularized by such periodicals as *Hutching's California Magazine* (1859) wherein one could read of and see (appropriately) woodcuts of a cotillion of 32 persons dancing atop a single recently-cut stump (Figure 7), and even Queen Victoria could see a reconstructed *Sequoia gigantea* in her native London.

By 1853, Coppinger's early wood-cutting empire in San Mateo County had been invaded by newcomers, and no fewer than 15 sawmills (all or most of them water-powered) were in operation, the timber pirates going through his timber while he tried to get the new government to confirm his title to the land. Also in the northern part of the Santa Cruz mountain range, backwaters such as the "Rancho de las Pulgas" (ranch of the fleas) was now coming to be known as "Redwood City", after the amount of lumber processed there for the short journey northwards to the end of the peninsula. Forester Mark Hannon (personal communication) notes that many, if not most, Californians mistakenly believe that Redwood City was originally heavily forested by the its namesake trees. Redwood City was

simply the transshipment point to San Francisco or to San Jose for lumber cut to the west, in the higher elevations of the eastern slope of the Santa Cruz Mountains. McCrary (1981: 6), for example, notes that lumber schooners loaded with cut redwood planks and beams embarking at Redwood City at high tide could make it all the way to San Francisco on the outgoing tide without relying on the (often) variable wind.

Nor were the timber resources of the Sierra Nevada neglected. James Hulse built the first sawmill in Fresno County's Pine Ridge area, below Corlew Meadows as early as 1852, but he either sold it or, in true Gold Rush fashion, lost it as a poker game stake to Alexander Ball in 1854. Alex Ball, who moved the mill farther back in the forest, where Ball Mill Meadow was the upper end of Corlew Meadows, was a good worker, but as bad a poker player as Hulse. In 1857, when he was $7,000 in debt from gambling, the mill burned down and he went bankrupt (Vandor, 1919: 158). A rough road from the Hulse-Ball mill was cut over Big Sandy Mountain and down Morgan Canyon to get the mill's products to what would later be called Tollhouse, at least a dozen years before the Woods brothers hacked out their trail so that Indians could carry splitstuff down the mountain. Among the early bull-whackers for the Ball Mill were George Green, Joseph Elliott, Bill May (for whom a mill was named), and Tollhouse's founder, Abe Yancey (Vandor, 1919: 158; Poling, 1974: 140-9).

Dozens, then hundreds of failed miners flocked to the forests of California as early as 1850, in many cases trying to produce salable lumber, usually splitstuff, on a solo or partnership basis. Trees with very straight grain were individually selected within the forest, felled, bucked into shorter log lengths, and then split into planks, rails and even parallel-sided beams with iron and later with steel wedges. Short log rounds were turned into shakes and shingles through the use of a "fro", or shake-maker's blade.

One such early "timber prospector" was Hale Dixon Tharp (R. Dillon, 1988a), the best-known early settler of the upper Kaweah river in Tulare County. Born in March of 1830, Tharp came to Hangtown and Mud Springs, now El Dorado, in 1852. He lived in Placerville until 1856, then meandered south, eventually becoming locally famous for living inside the hollow trunk of a giant Sequoia. In 1910, when he was a very old man, Tharp claimed:

> "The Indians told me that I was the first white man that had ever come into their country. But few of them had ever seen a white man prior to my arrival. The Indians all liked me because I was good to them" (Small, 1926: 261).

In 1858, Tharp was the first white to visit Giant Forest and what would later become Sequoia National Park. He was either the first or the second White man to see the General Grant Grove and Kings Canyon, possibly being preceded by J. H. Johnson in 1856. There is no doubt, however, that Tharp discovered the Kings River, Tule River, and Deer Creek redwood groves by 1862, and helped to give the Sierra Nevada its well-deserved reputation for rich timberland. By 1864, there was a sawmill operating near the General Grant Grove, and at its 1868 meeting, the Tulare County Board of Supervisors granted Hugh Hamilton and W. S. Powell, and others, the exclusive right to float saw -logs down the Kaweah. "This act was so ridiculous it was treated as a huge joke." (Memorial, 1891: 199).

To the north, much of the timberland of Fresno County was prospected by Charles P. Converse, whose name, if not his reputation, is still known to many

Figure 8: Falling a California Redwood in the North Coast Ranges, with the use of multiple springboards, 12-foot misery whip, *wedges, axes and mallets. Humboldt State University Library photo, reproduced from Williams, 1976: 118.*

Californians. Converse was a Georgian, a striking 49er, six feet tall and weighing 200 pounds at a time when most men were small in stature. He mined in Mariposa County before coming to the San Joaquin River to look for gold, raise cattle and run the Rancheria Flat ferry near Millerton. As early as 1851, he and Theodore Stallo were general merchants in Coarsegold. Converse built the Millerton courthouse and jail, and had the dubious honor of being the first prisoner incarcerated in the latter. Converse was jailed for shooting a man to death in an election-day political squabble, he was released when his action was judged to have been in self-defense (Vandor, 1919: I, 137-38; 153; R. Dillon, 1988b: 319).

In 1865, disgusted with life in low-elevation California, Converse withdrew from Millerton, heading for the remote high country of the King's River-Millwood ponderosas and "Big Trees," or sequoias, where Converse Basin was named for him. He homesteaded timber land amongst the big trees, planning to cut the virgin redwoods there, but instead of laboriously freighting the timber or milled lumber down by wagon, his idea was to simply float the logs down the Kings River to a railroad connection and lumber mill in the San Joaquin Valley, supposedly proving such water transportation feasible by getting a few logs all the way down. Converse was a glib and plausible talker, and interested some capitalists in his venture, but they dropped his plan during a financial recession (Vandor, 1919: I, 138-39). In any case, few logs would have made it safely to any valley-floor mill because of the tortuous, rocky bed of the Kings. While Converse got out of the lumber business before he could do too much harm, he nevertheless focused

attention on the timber wealth of the Kings River drainage of the southern Sierra Nevada.

When an early California logger found a comparatively dense concentration of trees suitable for splitstuff production, frequently the first tree felled was split on the spot and a small cabin was built from the planks and shakes thus produced. Frank McCrary (personal communication) states that family members, loggers, in the late 1800's in the Santa Cruz Mountains loggers could put up such a cabin in only a few days, then spend an entire season making splitstuff while using the cabin as a base of operations. Once the splitstuff had been hauled out and sold, the cabin was normally abandoned, and the process repeated elsewhere (McCrary, 1981: 29). Many such "splitter's" or "shakemaker's" cabins existed in the Coast Ranges and Sierra Nevada into the 1960's, when most of them were knocked down in response to the invasion of "Hippie" squatters that came to occupy them towards the end of that decade. ago.

The big trees were still cut with axes, but, increasingly, with long two-man saws or "misery whips" (Figure 8). Most skilled axemen could plant a stake 30 to 50 feet from the trunk of the tree being felled and hit it every time with the falling tree once the final cut had been chopped through. Until the late 1860's or early 1870's, the crosscut saw was rarely used to fell the largest trees in California, the feller's axe having being employed instead. The problem was that the sawteeth would "load up" with sawdust, and the saw would jam. A solution was developed with the invention of "rakers", or cleaning teeth not intended to cut, but simply to remove sawdust (MacKay 1978). Unlike the old, short-length Spanish and Mexican iron saws, the new, Yankee-style saws were now in some cases ten or twelve feet long, and made hardened iron, and later, of spring steel. Steps were cut into the lowermost 5 to 10 feet of the trunks so that the fellers install springboards high off the ground and consequently reach and saw through a narrower portion of the trunk than the much wider spreading base at human shoulder height. The springboards were inserted in axe or saw-cut grooves, giving the fellers foot platforms high above the ground level to stand on for hours or even days during the cutting of a single tree. The largest trees could sometimes not be felled (Verardo and Verardo, 1987: 26) and consequently were left standing, as their diameters were in excess of the longest two-man saws, although in some cases such giants were sometimes "drilled" (i.e., a series of deep auger holes were bored in towards the heart of the trunk from all directions, then connected through chiseling, spudding, or the remaining wood fibers were broken through driving in steel wedges.

Producing splitstuff single-handed was a good way to make a living, but not to get rich: this goal could only be achieved by putting lumbering on a completely different scale, with large teams of well-equipped loggers supported by companies speculating in lumber prices. With the infusion of "Yankee Know-How" (read cheap iron and steel technology) into California, tree-felling and log-hauling became much easier processes than before. Hardened steel wedges and Collins axes became generally available, and as manual logging equipment became cheaper and more common, lumbering became more profitable.

The fallen trees were still limbed and trimmed with axes and smaller saws, including, increasingly, "buck" or frame saws with narrow blades and top tensioners to keep them rigid. Again, most of this work was done by single loggers, even when working with "two-man" saws. The trimmings most often were discarded, only on rare occasions being saved for splitstuff. Most usually, after logging, the slash was piled up and burned, or simply burned in place. Only after 1880 or so was

Figure 9: Moving a multi-ton redwood log with two ratcheted log jacks at Fort Bragg, Mendocino County, circa 1890. Union Lumber Company photo, reproduced from Andrews, 1957: 120.

some of the trimmings saved as firewood to power the steam donkey engines that were coming to be used in the mills to power the saws. The abundance of large diameter trunks with straight grain, however, mitigated against much use of limbs and branches before the conservation movement began after the turn of the 20th century. After felling, the long trunks were then bucked into manageable lengths 10 to 20 feet long, again with the use of the two-man saw; this was still back-breaking labor, but not as difficult as the actual tree-felling as gravity now aided the passage of the saw.

As the dry diggins and placers became exhausted, and the Gold Rush moved into its second decade, hard rock mining became the mainstay of the California gold country. After 1859, with the Comstock silver strike in Nevada, gold and silver mining truly became "mining", with most gold-seekers now tunnelling deep into the earth in search of rich veins no longer visible on the surface. Concomitant with quartz, or hard rock, mining a new demand for California lumber developed, on both sides of the Sierra Nevada. Deep mine shafts consumed immense amounts of timber for braces and supports, and the steam donkey engines that turned the giant wheels lifting ore to the surface or which pumped constantly encroaching water out of the shafts burned tons of fuelwood on a daily basis.

With the advent of hard rock mining, almost overnight an ironworking industry grew up in San Francisco so as to serve the mines (R. Dillon, 1984) and ships coming through the Golden Gate now carried iron ingots, scrap, or even ore as ballast to feed the forges responding to the machinery demands of hard-rock mining. The California logging industry benefited indirectly; heavy chain began to be made on "speculation" and could be bought from ironworkers for the first time, instead of being "made to order" by the local blacksmith, or "delivered" after a delay of up to a year from east coast producers. The invention of the

geared and ratcheted "log jack" (Figure 9) after the Civil War enabled one logger to do the work of many, who previously had to move cut logs with long levers or with mule or ox teams. "Hand logging" as it developed during the gold rush years in California was just that; trees were felled and moved by hand. What is not often appreciated is the fact that many, if not most, hand loggers worked by themselves in the woods, performing all the tasks required alone.

Frank ("Lud") McCrary (1981) offers a unique perspective from his own experience of old-time carryovers into the modern period. As late as the 1940's McCrary and other members of his family were still felling trees with two-man saws or "misery whips", frequently doing this back-breaking chore alone. McCrary's account (personal communication) of "one-man" logging is fascinating: trees were felled with 7-foot whipsaws so that gravity would take them as far down hill as possible, and "limbing and trimming" and bucking the logs was also done with whipsaws and log jacks. The log jack was a heavy iron jack with a ratchet and spike or cleat on its traveller that one man could stab into the side of a heavy log and through much exertion, move or "walk" the whole log with it until it could be bucked more easily or started on its journey downhill to the logging trucks or tractors. Moving logs this way was called "gulching".

With the coming of the gringos, the ox-teams also grew larger and ox-team technology also became more efficient. The normal two-yoke team could now pull 3 or 4 log lengths instead of a single one because most skid roads were now "corduroyed", and the skids, normally spaced 5 feet apart like railroad ties, were greased with beef tallow or whatever else came easily to hand. The modern term "greasing the skids" (to make something go easier), is of course derived from this lumbering application. With more time and trouble invested in grading and surfacing skid roads, larger and larger ox-teams hauling longer and longer strings of logs was the result.

The lengths of the cut logs were determined by the capability of the mill they were destined to accommodate them, and by the limitations of the ox-team prime movers. Frank ("Lud") McCrary, whose family during the early years of the present century was still engaged in animal-powered lumber transportation in the Santa Cruz Mountains, estimates that the average log length pulled by ox-teams was around 16 feet. The log lengths had their leading edges beveled so they wouldn't "hang up" on the skidroad, and were then rolled with levers or dragged down by mule or ox teams to the nearest skid road, where they were lined up one behind the next, end to end, and "dogged" or cleated together with heavy chains.

Ten, twelve and even fourteen-ox teams hauled upwards of 20 log lengths (depending, of course, on the grade of the skid roads) and bull "drivers" or "whackers" (actually "ox-bosses") constantly engaged in friendly competitions over who could drive the biggest team or pull the longest string of logs. McCrary (1981: 16; see also Payne, 1978: 60) notes that one such champion late 19th-century bull-driver, Chris Ifert, was able to haul 57,000 board feet of logs, calculated at 600 tons, with an ox-team of only 12. In such extreme cases, however, the oxen, once they had "jerked" the logs out of a state of inertia, probably did little more than "steer" the string down slopes which enabled gravity to do most of the work.

Motive power from the 1850's to the turn of the century was usually provided by ox-teams of up to a dozen animals yoked two abreast. While the "horsepower" of such teams seems limited by today's standards (i.e., a "yoke" of twelve oxen generating at best 20 to 30 brake horsepower) the torque or low-gear pulling power generated was not inconsiderable. It should also be remembered that

Figure 10: The last yoke or pair of an ox-team pulling cut logs on a solid-wheeled cart downhill to the mill. Such carts were commonly used in Northern California and Southern Oregon from about 1870 to 1900, depending upon terrain. Reproduced from Schmitt & Brown, 1955: 81.

once the string of cut log lengths was moving (albeit slowly) gravity normally helped it along and as long as inertia was not allowed to re-establish itself, comparatively few oxen could move many tons of logs downslope over quite a few miles without undue strain. After 1850, the oxen in logging bull teams began to be shod, as their hoofs would otherwise splinter on the rough skidroads now being built in the golden state's forests. The blacksmith usually had his shop at the sawmill, but, infrequently, in the woods depending upon the amount of animals employed on a given job. Logging blacksmiths were kept busy all the time repairing the logging chains used in hauling the logs with ox-teams, and with shoeing the hundreds of oxen in daily use. Blacksmiths, mule-skinners and bull-drivers were at least as important as the timber-fellers, and often were actually paid more if they were particularly skilled. Stock-raisers, animal breeders, and veter

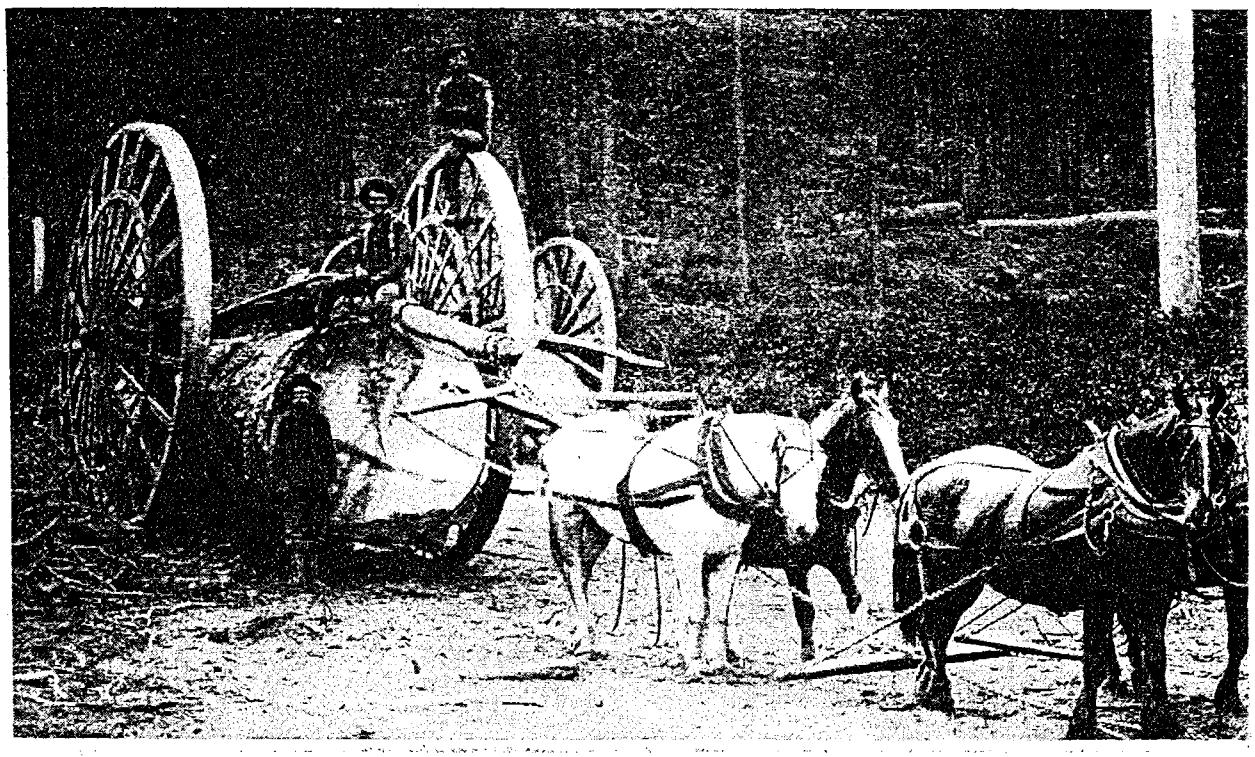


Figure 11: High wheel logging by the McCloud River Lumber Company, Siskiyou County, California. Collier State Park Logging Museum photo, reproduced from Andrews, 1957: 92

inarians assumed an importance to the timber industry from the 1850's until as late as World War I as to be only imagined today.

While most logs were in fact "skidded" (i.e., dragged) along skid roads by ox or mule power, towards the end of the 19th century two improvements on the method were introduced in California, and were popular in the north-central part of the state. The first of these improvements was the use of great log wagons (Figure 10) with solid wooden wheels, frequently with iron rims, upon which multiple cut log lengths could be stacked. Because the "drag" associated with skidding logs was eliminated, loads could be moved much faster and with fewer oxen. The second improvement was the introduction of the horse- or mule-drawn "Michigan" Big Wheel, or "high wheel" system (Figure 11); these were a pair of light-weight, spoked wheels 12 to 15 feet high linked by an arched axle. The pair of wheels was run over a single large or several small log lengths, which were chained up to the arch from below. The forward pull of the team on the tongue lifted the forward end of the log and eliminated most of the "drag" and inertia, allowing, again, great weights to be moved with a much smaller investment in animal power than with simple skidding.

The drawbacks to both systems were that only trees of comparatively small diameter could be moved, and both methods were essentially restricted to level ground. This being the case, neither was ever very successful in the Sierra Nevada or in the Coast Ranges. The Michigan-California Lumber Company (Polkinghorn, 1984: 11) tried solid wheel wagons for a while, pulled by 8-ox teams and carrying up to 20 tons of logs, but most of the El Dorado County timberland was too steep, and the experiment was abandoned. Both methods were commonly used in Central Oregon, and those parts of north-central California, essentially within Siskiyou, Shasta, Modoc and Lassen Counties with similar

forested terrain, also used both systems to advantage. Rock (1986: 60-61) notes that the Weed Lumber Company of Siskiyou County used big wheels exclusively until 1907; they were still used in British Columbia until the 1920's, long after they had been replaced by steam donkeys or tractors in California.

While ox-teams and sawpits disappeared from the California lumber industry many decades ago, the sawpit system continued on in use in many non-industrialized parts of the world. The sawpit method was still employed in British Columbia as late as 1914 (Gould, 1975: 41) and remains common throughout forested Central and South America. In highland Honduras, for example, the main source of income is still from lumbering, and in the absence of electricity, roads, or internal combustion engines, whipsaws, as two-man sawpits, and ox-teams are still used on a daily basis, albeit primarily with small-diameter pines. In lowland Guatemala, however, mahogany and other hardwood trees in excess of 200 feet high are taken down "the old way", with sawing platforms built lattice-style fifteen feet above present ground level so as to clear the massive buttress roots of these forest giants. Although geographically far removed from California, it is nevertheless instructive to see Central American human and animal-powered logging operations still going on today as a means of understanding and reconstructing similar efforts in 19th-century California.

Coastal Logging and Lumber Schooners

The earliest transport of commercial lumber in California, in the 1770's, was by sea. During the Spanish and Mexican periods the overall volume of lumber so shipped was small, but two geographical factors encouraged such California timber pioneers as Steven Smith and Thomas Larkin to continue the maritime shipment of milled lumber into the Anglo-American period: the general absence of roads in California which would bear freight, and the fact that virtually all settlements of any size were on the coast in the first place.

By the 1840's the lumber camps on the Pacific side of the Santa Cruz mountains were shipping more and more lumber by sea to the consuming markets at Monterey, and, later, at San Francisco; with the Gold Rush, this maritime traffic doubled, and doubled again, and again. Lumbermen in the Santa Cruz mountains got their lumber to the San Francisco market via hauling their produce from the mills via ox or mule-drawn freight wagons down to the wharfs at Davenport, Santa Cruz, Soquel, Aptos, and other locations, then loading it directly upon freight scows or larger steam or sail freight vessels. As early as 1850, many large landowners in San Mateo, Santa Cruz and Monterey Counties were building their own private wharfs just so that they could ship redwood lumber to San Francisco more rapidly.

Verardo & Verardo (1987: 26) state that by 1857 there were 10 sawmills in Santa Cruz County, with a combined total production of 40,000 board feet of lumber per day. This was fairly small potatoes compared to what would come later, but when contrasted with that of only a decade before (i.e., under Mexican Governmental authority) the daily rate just for Santa Cruz County probably far exceeded that for the entire Mexican province on an annual basis. By 1864, 28 sawmills were operating in the San Lorenzo Valley alone, producing almost 35 million board feet of lumber annually; at least some of these mills were by this time steam-powered. But, as steady as the supply from the Santa Cruz mountains was, it paled in comparison to the new redwood bonanza that was developed in the North Coast Ranges after California statehood.

From Bodega Bay to Humboldt Bay, the north coast came to be settled not by gold-seekers, fishermen, or farmers, but by lumbermen, all of whom, at first, expected to ship their product by sea down the coast to San Francisco Bay, where the biggest lumber market west of the Mississippi River had sprung up overnight. Some lumber prospectors made millions of dollars from redwood, others went broke, and the lure of the north coast also inspired perhaps the strangest form of water-powered sawmill in California, that reported to have been built by Chinese lumbermen in the early 1850's north of San Francisco Bay. This was a sash-bladed mill powered by the tidal action of the Pacific Ocean (Andrews, 1957: 115), and little other information is available on it.

One of the earliest destinations of the rush to capitalize on the potential wealth of lumbering in the redwood forests was the town of Mendocino, and in fact, Mendocino County itself, both born out of the California lumber industry. Mendocino County was one of the largest in northern California, and also one of the original 27 counties of California at the time of Statehood in 1850. Nevertheless, it was so sparsely-populated that it was administered by neighboring Sonoma County until 1859. What turned it into one of the richest counties of the new state was its vast redwood timber resources.

The first big year for exploitation of north coast redwood timber was 1852, with sawmills built at Big River (Mendocino), Albion, and even at Arcata on Humboldt Bay. The event which triggered this scramble to get in on the ground floor of the North Coast lumber boom occurred two years before. The Baltimore brig *Frolic* was wrecked on the Mendocino coast just north of Point Cabrillo near Caspar on the night of July 26, 1850, and through the reports of tall timber near the wreck site carried by her survivors, and by the unsuccessful salvage team which had set out from, then returned to, San Francisco on the orders of Alderman Henry Meiggs, the potential profits of a Mendocino coast lumber operation became evident (Layton, 1990: 176-177).

Alderman Henry ("Honest Harry") Meiggs of San Francisco was an ex-New Yorker who had come to California in 1849 with a load of lumber around the horn. Meiggs sold this first batch of lumber in the City by the Bay for 20 times his original investment, reportedly making $50,000.00 profit (Williams, 1976: 70). While others searched for gold, Meiggs got rich through continuing what had been his career on the East Coast, becoming one of the first San Francisco mill owners and lumbermen. Meiggs built a steam-powered sawmill in North Beach, and floated redwood trees cut around San Francisco Bay back to his mill in rafts, Meiggs made an estimated $500,000.00 within the first few months of beginning his operation, prices being what they were in California of 1850. Meiggs quickly realized that the problem with a sawmill in San Francisco was that others owned the timberland which fed it, and when the *Frolic* shipwreck indirectly brought news of vast, uncut stands of redwood to the north, he began to make plans.

Meiggs had a steam-powered lumber mill shipped around the Horn from the East Coast so as to take advantage of the rich timberland of the central Mendocino coast. In 1852 the chartered Brig *Ontario* pulled in to the mouth of the not overly-imaginatively named Big River, and unloaded the elements of the mill, which was soon set up and operational on the north bank just below the headland. Meiggs' first Mendocino County mill had a productive capacity of 50,000 board feet daily, and soon he had built a second mill as well. Meiggs' venture was a resounding success, and the camp up on the headland just to the north of the first mill came to be known as *Meiggstown* for a while, then as *Big River*, and finally, as *Mendocino*. The Mendocino mills were built by the *California Lumber*

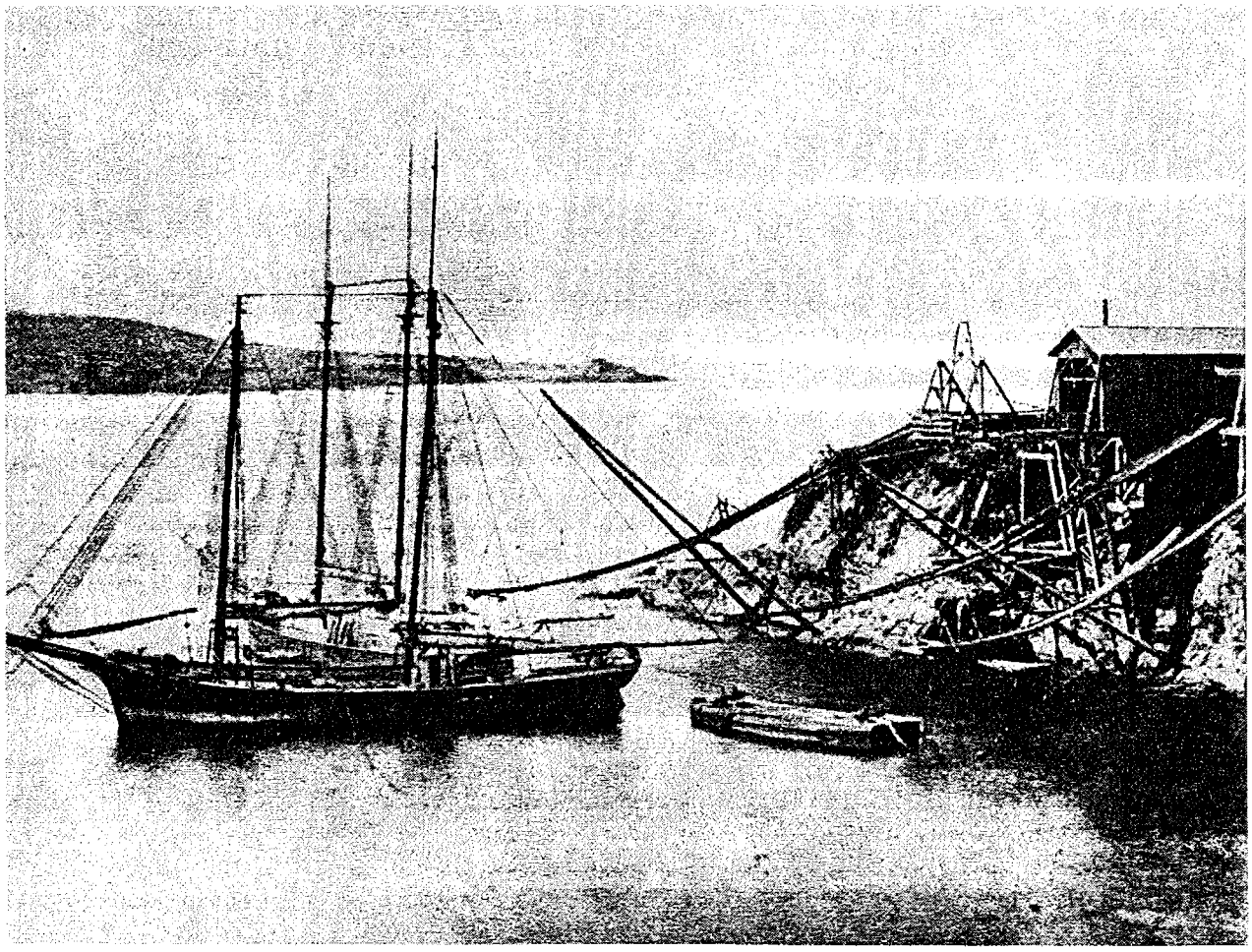


Figure 12: Two lumber schooners being loaded with milled redwood in Mendocino Harbor from apron chutes, 1865. Union Lumber Company photo, reproduced from Andrews, 1956: 160

Company, formed by Harry Meiggs, Jerome Ford, and E.C. Williams.

Mendocino's rejection of the *Meiggstown* name was fortunate, as within two years (1854) Meiggs had disappeared, leaving many debts unpaid, and worse, was found to have stolen some $800,000.00 from the City of San Francisco. "Honest Harry" soon reappeared in South America, where he was so broke he had to pawn his gold watch. But, ever resourceful, Meiggs now became a banker and railroad builder in Chile and Peru, far out of reach of the long arm of the law. His rail lines into the through the Andes were built on ties made of California redwood shipped the long way down from his old mills on the Mendocino Coast. Eventually, Meiggs became that rarest of 19th-century birds, a South American millionaire, and did what no modern politically-appointed thief would ever contemplate: he voluntarily paid back the money stolen from San Francisco.

Meiggs was not the only one to catch "redwood fever" in 1852. To the south, Captain William Richardson, after whom Marin County's Richardson's Bay is named, built a small, water-powered sawmill on Mendocino County's Albion River (the second in the County after Meiggs' Big River mill) a few months later (Andrews, 1957: 115; Williams, 1976: 7; Hoover, et. al, 1990: 195). To the

north, also in 1852, a sawmill was built on the Noyo River by George Hagenmayer. Local Indians resisted this operation, and in 1854, a major high tide, coupled with extreme rainfall inland, lifted the Noyo mill off its foundations and floated it out to sea.

Captain Richardson, until the Mexican War a Mexican citizen, had claimed the land since 1845 as a Mexican grant, but this was not confirmed after California statehood. Albion was the ideal spot for this early industry; it was fairly close to the San Francisco lumber market, two day's voyage by sailing vessel, and the headwaters of the river lay in rich redwood timber. A second mill was built on the Albion River in 1853, this time powered by steam. In 1856 this mill was owned by A.W. MacPherson, a Scot, and his partner Henry Wetherby. This steam-powered mill burned in 1867, but was soon rebuilt. The two partners went on to organize the *Pacific Lumber Company* in Humboldt County to the north, essentially opening up the northernmost California coast to lumbering from the early "beachhead" in Mendocino County. MacPherson died in 1880, and the old Albion mill was taken over by the *Albion Lumber Company*, now owned by Miles Standish (a descendant of the famous pilgrim) and Henry Hickey. The new owners kept the mill running until 1895, then sold it to the Southern Pacific Railroad, which operated it until its closure in 1929.

Although farther from San Francisco than Albion, Meigg's Big River operation nevertheless had a much greater drainage basin than did Richardson's and much more timber within its watershed; Meiggs' hope was that some of the timber cut inland could be floated down to the mill at the mouth of the river in a small, protected embayment on the coast. Andrews (1957: 121) shows a photograph of the mill at the mouth of the Big River, but labels it "Second Mill at Mendocino City", and contradicts other information in his text by stating that it was built in 1854, and that it employed a muley or sash saw, as well as two circular saws, and that its capacity was 60,000 board feet per day. The Big River Mill burned down in 1863, but was rebuilt and continued operation until 1938.

At the other end of the line, Meiggs' Wharf was built in 1853 so as to accommodate the growing influx of redwood lumber from Mendocino; the lumber schooners from Big River could now load from and unload to facilities owned entirely by Meiggs himself (R. Dillon, 1985: 55). The wharf was in San Francisco's North Beach, near the end of Powell Street at Mason; today it lies deeply buried beneath deep landfill and the rubble of the 1906 earthquake. To service his new wharf, Meiggs also built a large lumberyard, and either moved his previous San Francisco sawmill or added another to his new operation where today's Francisco and Mason Streets intersect.

Steam-powered sawmills revolutionized the California logging industry and placed it in the forefront of all the western timber states by the mid-1860's. The great benefit of steam-powered sawmills over water-powered ones was, of course, that while water-powered mill locations were limited to stream channels with enough flow to power a millwheel, steam mills could be set up almost anywhere. Steam-powered sawmills could run (at least theoretically) all year round as long as enough firewood and water to fill the boiler could be found. As lumber was cut farther and farther from the mill, the steam-powered sawmill was found to offer yet another advantage: it could be knocked down and reassembled with a minimum of difficulty adjacent to new, uncut, stands of timber, keeping transportation costs down.

Figure 13: The Mendocino Lumber Company Wharf in San Francisco, circa 1865, with the redwood planking stacked high in the foreground, and the sailing vessels which brought it down the coast in the background. Photo from Union Lumber Company Collection, reproduced from Williams, 1976: 50.

The advent of "steam power", however, did not immediately render earlier energy forms obsolete, as the trees were still felled by human muscle power, and logs were still brought to the mill and finished lumber still shipped from the mill by animal power. For several decades after steam-powered mills made their appearance, the majority of sawmills were still water-powered. Even as late as the 1880's, once donkey engines began to be used for pulling logs down to the mill, ox and mule-teams still worked nearby in the more inaccessible areas, or on "lower budget" logging operations, and this pattern continued well past the turn of the 20th century.

Dozens of mills and milltowns sprang up along the "redwood coast" of Mendocino and neighboring counties as new forest lands were opened up for logging. In 1856, a water-powered sawmill was built in the Anderson Valley on the Navarro River by John Gshwond, and in 1860 a steam-powered sawmill was built on Caspar Creek, midway between Mendocino and Fort Bragg. The mill burned in 1889, but was rebuilt and back in business by 1890. Still in operation by 1955, the Caspar Mill was the longest-operating steam-powered sawmill in California, if not on the entire Pacific Coast. In 1862, John Rutherford and George Webber built a steam-powered sawmill at the mouth of the Gualala River on the Sonoma-Mendocino County line. This mill was in continuous operation under various owners until 1906, when it burned down as did so many other early California sawmills.

Farther up the Coast, at Fort Bragg, sawmilling got a comparatively late start, for the first mill was not built until 1885, by the *Fort Bragg Redwood Company*. The mill burned down in 1888, and was rebuilt in 1891 when the *Fort Bragg Redwood Company* merged with the *Noyo Lumber Company* to form the *Union Lumber Company*, headed by C.R. Johnson. Johnson's new mill at Fort Bragg was one of the first to use band saws, which were better suited to cutting the giant redwood logs than the old circular blades. Between 1906 and 1916, the ULC stored cut redwood logs as "floaters" in Pudding Creek during the winter months, pulling them out on an inclined track and loading them on flatcars for the 1-mile rail trip to the Fort Bragg mill. Up to 20 million board feet of lumber would be stored in such fashion at a time (Andrews, 1957: 115). C.R. Johnson, with his partners, also operated the *National Steamship Company*, which at one time owned no fewer than 9 lumber steamers running between the Mendocino coastline and the docks on San Francisco Bay.

Far to the north, the creation of the first lumber mill on Humboldt Bay is remarkable, it not unique. The first mill at or near Arcata was powered by the side-wheeler *Santa Clara*, which had been floated over the Humboldt Bar by her captain James Ryan in 1852 and beached on the shore of Humboldt Bay. Ryan had previously laid out the town of Eureka in 1850, as was optimistic as to the prospects in lumber on Humboldt Bay. The steamer's paddle wheels were dismantled, and drive belts were rigged to the *Santa Clara's* paddle wheel axles, so that saws on either side of the hull could be powered simultaneously, and a roof was built over the sawing area. After six weeks of work, the boiler was fired up, and four circular saws on the bayshore cut between 40,000 and 85,000 board feet of redwood lumber daily at what was now called the Ryan and Duff Sawmill. The ship's galley served as the cookhouse for the sawmill crew, which also, of course, slept aboard the vessel. The first three ships to be loaded with lumber from Ryan's sidewheeler mill all foundered trying to cross the Humboldt Bar, but the fourth made it over and the Humboldt Bay area began a long history of supplying timber to San Francisco (Andrews, 1957: 115; Genzoli, 1973: 27-28; Williams, 1976: 70). By 1854, $100,000.00 had been invested in the enterprise,

which was at that time employing 24 men; a turning lathe, planing saw, shingle machine, and many other features has been added by this time. The mill made from the old *Santa Clara* burned down in 1859.

Unlike the maritime lumber business of the California's south coast ranges, where milled lumber was loaded directly onto sailing vessels or steamers from wharfs on pilings, the rocky, wind and wave-whipped northern California coast required less conventional means of getting lumber from the high headlands to the ships lying off the treacherous shore. At first lighters were used, but lightering out loads of lumber through the surf and rocks is cost-ineffective at best, and suicidal at worst. Eventually, loading facilities, and even the coastal mills themselves, were located at the best *Dog holes* on the exposed and stormy coastline from northern Sonoma County to the Oregon line.

Dog holes were small indentations in the rocky northern California coastline, where schooners, scows and later steamers, would anchor during good weather and lumber could be slung down to them on cables from the mills on the coastal headlands. Where offshore water was deep enough, the lumber ships would anchor close in enough to allow for lumber to be chuted down onto their decks (Figure 12) via wooden lumber chutes suspended first by rope, then by cable, often with vertical pillar supports resting on rocks which would be completely submerged at high tide. One of the most elaborate *Dog hole* loading systems was built at Cuffy Cove, on the coast near the mouth of Greenwood Creek, between the Navarro River and Point Arena, in 1876. Here, narrow-gauge flatcars loaded with lumber moved by gravity down a long, elevated trackway out to a loading point where the planks were slung on cables out to the lumber schooners anchored just off the rocky shoreline. (Andrews, 1957: 119). After a few years of operation, the mill and trackway became the *Redwood Lumber Company*, then later the *L.E. White Lumber Company*, later still the *Goodyear Redwood Company*, and finally as the *Elk Redwood Company*. The operation finally closed down in 1936.

By 1900 a crude system of dirt roads now linked Mendocino and Humboldt counties with the rest of California, but these were unequal to the challenge that heavy freightage of lumber presented, and most lumber still was shipped by sea. The railroad from Fort Bragg to Willits was finally completed in 1911, and for the first time, Mendocino lumber could be shipped by rail to San Francisco, traveling by water only over San Francisco Bay on the ubiquitous ferryboats which provided the main form of transportation prior to construction of the Golden Gate Bridge in the late 1930's. With the coming of the railroad, the 60-year history of shipping redwood down the coast in lumber scows and schooners finally came to an end.

Logging and Road-Building

Road-building in many counties of California's mountainous interior today is in large measure dependent upon the logging industry: first the skid roads go in, and in some cases, these later become major haul roads, and finally, in a few cases, the haul roads become county thoroughfares and acquire paving. In the mid-19th century, the connection between the lumber industry and the development of roads throughout much of California was even more pronounced, for timber was the most important heavy freight regularly distributed throughout the state, but in most cases the tall timber was many miles away from the consuming market. To get the lumber from the woods to the market often involved major engineering efforts in cutting roads through steep mountains and building

bridges. In many cases, only after the roads were in did settlement become established along the new thoroughfares.

During much of what is sometimes gratuitously labeled the "steam age" as applied to the California logging industry, only the mills themselves were actually steam-powered: logs coming to the mill and lumber leaving it were still moved by animal power. The old familiar ox-team normally had the job of wrestling the heavy log lengths down to the mill for cutting, and milled lumber was usually transported on heavy, high-wheeled wagons hitched in tandem, and pulled by "jerklines" of up to a dozen or more mules, less frequently horses, yoked side-by side in pairs (McCrary, 1981: 22). Each wagon might be loaded with up to 4,000 board feet of lumber weighing up to ten tons; steep grades were negotiated by unhitching the trailing wagon, hauling up the lead wagon, parking it, then going back downhill to bring up the "trailer" for a second ascent. Going down such grades was sometimes too dangerous with the wagons "freewheeling", so the wheels were chained or "barred" so that they couldn't turn and the heavy load was slowly "sledded" downhill (ibid). Obviously, any wheeled freight vehicle was useless without adequate roads.

A good example of the impact of the lumber industry on California road development is the story of Pine Ridge in the southern Sierra Nevada. The broad belt of commercial timber in the Pine Ridge district of upland Fresno County, 25-by-60 miles (150 square miles) by conservative estimate, held perhaps as much as 9,600,000,000 board feet worth cutting, worth many millions of dollars even at pre-inflation mid-19th century value. In fact, many believed that the country's lumbering resources were almost beyond comprehension. The sugar pine was most valuable, providing fine-grained, soft wood that was ideal for window casings, doors, and sashes. But yellow, or ponderosa, pine, red and white fir, cedar, and redwood or giant sequoia were all nearly as profitable (R. Dillon, 1987). The first stage of Pine Ridge lumbering began in 1852-1854 and ended in 1866-67, while a second stage got underway in 1881. All Pine Ridge timber was on government land, unrestricted until 1880. In that year, U.S. deputy surveyors laid out the land in sections, and, when the plots were accepted by the Department of the Interior, notice was published governing rights of entry and purchase. From the spring of 1881, timber land had to be purchased for $2.50 an acre (Winchell, 1933: 83-84). This second pattern of Pine Ridge lumbering was complicated by mill fires, transfers of ownership, and physical movement of the sawmills. The third period of lumbering, the boom of the 1890's, was one of big mills, some owned by outsiders schooled in the forests of Michigan. Lewis P. Swift and Charles B. Shaver dominated this era (R. Dillon, 1987; 1988b).

One of the first steam-powered sawmills in the southern Sierra Nevada was built within two years of the end of the Civil War. J. H. and L. N. Woods, hunters and trappers, camped upon the Pine Ridge between the San Joaquin and Kings River drainages in the summer of 1866. There they made shakes to roof and side cabins. They had to hand-cut a trail down the steep 1000 to 2000-foot plunge of the Sierra Nevada slope to get their shakes from the Pinery to Big Dry Creek, probably along the north side of Sarvers Peak. They then bought wagons in Millerton, drove them to the later site of Tollhouse and disassembled them. They hired Indians to carry the parts--tongues, axles, wheels, yokes--up the steep trail for reassembly at their shake-maker's camp. They ran the wagons only upon Pine Ridge, for that was the only place level enough. The Indians had to carry bundles of shakes down the precipitous trail from the end of the rough road above. Since this was such slow work, the brothers began planning a wagon road on what would soon be called the Tollhouse Grade. In October of 1866, they got a fran-

chise for a toll road from the foot of Sarvers Peak to the forest and started work from the Widow Waite's place at the upper end of the projected road (Winchell, 1933: 80).

In December of 1866, Mariposa Mill owner John W. Humphreys, hearing of the wealth of timber in the Fresno County Pine Ridge country, sent his millwright and sawyer, Moses Mock, and an ox driver, Jerry Simms, with water-powered mill machinery, supplies, tools, etc., to create the a mill below the site of Kenyon's (or Armstrong's) Mill on Pine Ridge, near today's Tollhouse. The advance party built a rude cabin on the site of what would become Humphreys' mill and (surviving) two-story house. Humphreys, his wife, and two children arrived in January of 1867.

In February, Humphrey's men and Indians he hired from a nearby rancheria, began to help the Woods brothers and their road crew of Whites and Chinese from Millerton. After three months of back-breaking pick-and-shovel labor by the cosmopolitan labor crew, by May, there was a passable ox-road up the two-mile rise of 2000 feet paralleling the old trail. Beyond that point, heavy grading was necessary to push the road further, but Humphreys hurried a steam boiler, steam engine, and mill machinery up to the hogback, using eight yoke of oxen. From there, it was cross-country, cutting and hacking a trace through the woods down to the bottom of the canyon and up the other side. Then they pulled steeply up to the Woods brothers' rough Shake Road and on to the site chosen by Mock for the mill where Humphreys' "Lumber Ranch" would be built. While Mock installed the sawmill machinery, Humphreys brought his family from the Tollhouse area up to the new mill site.

The men gouged out a road from the top of the mountain to the Woods boys' shake trace, and Humphreys hired Indians to cut timber and work in the mill. By October 1, 1867, he was hauling lumber over the rough road, using five or six yoke of oxen per haul. There was so much demand for lumber that it was hauled "green from the log," unseasoned, as fast as it could be sawed. His first sale of lumber was at Smith's Ferry on the Kings River. During that busy summer of 1867, the Woods brothers sold part of their claim for $100 to Doc Howell of Kings River, who planned a health resort at the spring. At the same time, Humphreys hauled lumber from his mill and built for his family the first house of sawed lumber in the Sierra Nevada of eastern Fresno County (Winchell, 1933: 81-82; Poling, 1974: 148-149). The structure was built at what would soon come to be called *Tollhouse,* about 32 miles east of Fresno, on the way to what is still some of the most rugged country in California.

In 1874, C.D. Davis, Milton M. Jacks, and James J. (Black) Phillips formed a partnership and built a mill in Moore's Flat called the Lightning Striker. Unfortunately, the name was a jinx; the mill was hit by a bolt of lightning and burned down before it was a year old, but it was rebuilt (Vandor, 1919, I: 158; Winchell, 1933: 83, 100). Meanwhile, Humphreys had closed out his original mill at the end of 1873's lumbering season and in the spring of 1874, with Mose Mock, established two new mills, Clipper No. 1 and No. 2 in virgin forest, one at the site that was later the Littlefield Place, and the other at a creek a mile away. He made plenty of money, but sold them in 1874 or 1875. Also in 1875, Humphreys and Mock sold their Flintlock Mill, a mile or two south of the Clipper Mill. James Morgan gave it the name because it was old-fashioned and spasmodic in operation. The steam engine with its leaky boiler (which balked at maintaining steam pressure), and other machinery were antiques needing constant attention and repair, some having been used by "Black" Phillips at Banderita Flat in 1868.

In 1875, Glass and Donahoo, the new owners, advertised their Clipper Mills lumber in the *Expositor*. Common lumber was available from them in Tollhouse for $11 per thousand feet, clear flooring for $15, and "refuse" for $6. An advance deposit of $8 per thousand feet was required. In August of 1876 Glass advertised rough lumber up at the mill for $9 in cash per 1000 feet in quantities of 50,000 feet minimum, or at $10 per thousand if cash was paid for smaller quantities, and at $11 on credit. Clear lumber was still available at the Tollhouse yard, and the advance was dropped to just $6 per thousand feet (Vandor, 1919: 337, 345). By the late 1880's or early '90's there were many small "gyppo" operations in the woods. Some anonymous observer said "It looked as though whoever had a tin can, a buzz saw, and six bits started a sawdust factory." Vandor, or one of his informants, counted the rotting sawdust dumps on the edges of ravines after the turn of the century and guessed that there had been no fewer than 84 mill sites on Pine Ridge (Vandor, 1919, I: 159): this was quite a change from the days that splitstuff was carried down the mountain on the backs of Indian porters. Now more than 2,000 men were working in the woods around Millwood (McGee, 1952: 2-3, 5). By 1890, Fresno County lumbering was contributing $2,500,000 annually to the local economy, $560,000 in doors, sashes, ties, shakes, shingles and cordwood. (Elliott, 1882: 200; Thompson, 1891: 18; Memorial, 1892, 71, 85). For example, that year John Humphreys' mill produced 4,000,000 board feet, Jesse Musick's 3,000,000, William Ockenden's 1,200,000, and Smith and McArdle's 1,000,000.

Some 50 miles to the south, another logging road was built "the hard way" during one of the most unusual episodes in California's logging history. The road-builders were members of the *Kaweah Co-operative Commonwealth* (1886-1892), a utopian-socialist experimental colony on the North Fork of the Kaweah River that hoped to support itself through logging on a communal basis. A colony and a member in Traver, Charles F. Keller, hired Nort Tharp, Hale Tharp's son, as a guide to take him to the Giant Forest and immediately recommended the area as the future site for the colony. So, on October 8, 1885, fifty-three men filed 160-acre claims on a large tract of land, heavily timbered, on the Kaweah River's North Fork, including the Giant Forest. By the Timber and Stone Act of 1878 they had 60 days to pay $2.50 an acre (R. Dillon, 1988a).

On December 2, 1885, the Giant Forest area, four townships claimed, plus the fourteen adjacent townships, was withdrawn from entry pending an investigation. In effect, Land Commissioner W. A. Sparks rejected the colonists' applications (Thompson, 1892: 28). Rumors flew. There was suspicion that the socialist Commonwealth was just a front for the "Octopus"- -the greedy Southern Pacific Railroad Company. The colonists filed papers to incorporate a Tulare Valley and Giant Forest Road, called the "Giant Fraud Road" by its critics, to connect with the S.P. in the San Joaquin Valley. It was too grandiose a scheme for the limited means of the colony and it shrank to the Giant Forest Wagon and Toll Road, but the damage was done (Mitchell, 1976: 109; Doctor, 1968: 1).

Up until the 1880's, much of the Giant Forest's timber had been considered inaccessible because of the steepness of the Kaweah drainage terrain, but the colonists were sure that they could build a wagon road up to a mill in the mountains. The building of the Old Colony Mill Road, from 1,500 to about 7,000 feet elevation above sea level, was the colonists' greatest feat. A Tulare County historian (Thompson, 1892: 28) called it "one of the best mountain roads in California". The road was begun on October 8, 1886, by just five men wielding picks and shovels. There was no money for scrapers, blasting powder, or even horses and mules. The Utopians nevertheless really made the dirt fly, and the

men reached the clearing called Advance by the summer of 1886. It took 4 years to carve by hand the 18 miles of steep road, on a steady 8 percent grade, up the canyon of the North Fork to the Colony Sawmill, but work was completed in June of 1890. Will Purdy was the sawyer at Colony Mill, which was expected to turn out 20,000 board feet of lumber a day. It made enough to build Kaweah, but the mill never exceeded 3,000-4,000 feet a day because logging was laggard (Doctor, 1968: 3). Needless to say, the one and only attempt at "communal logging" in California was a failure, but the road scratched through some of the most difficult terrain in the Sierra Nevada by the Utopians, without even recourse to animal power, remains.

Railroad Logging

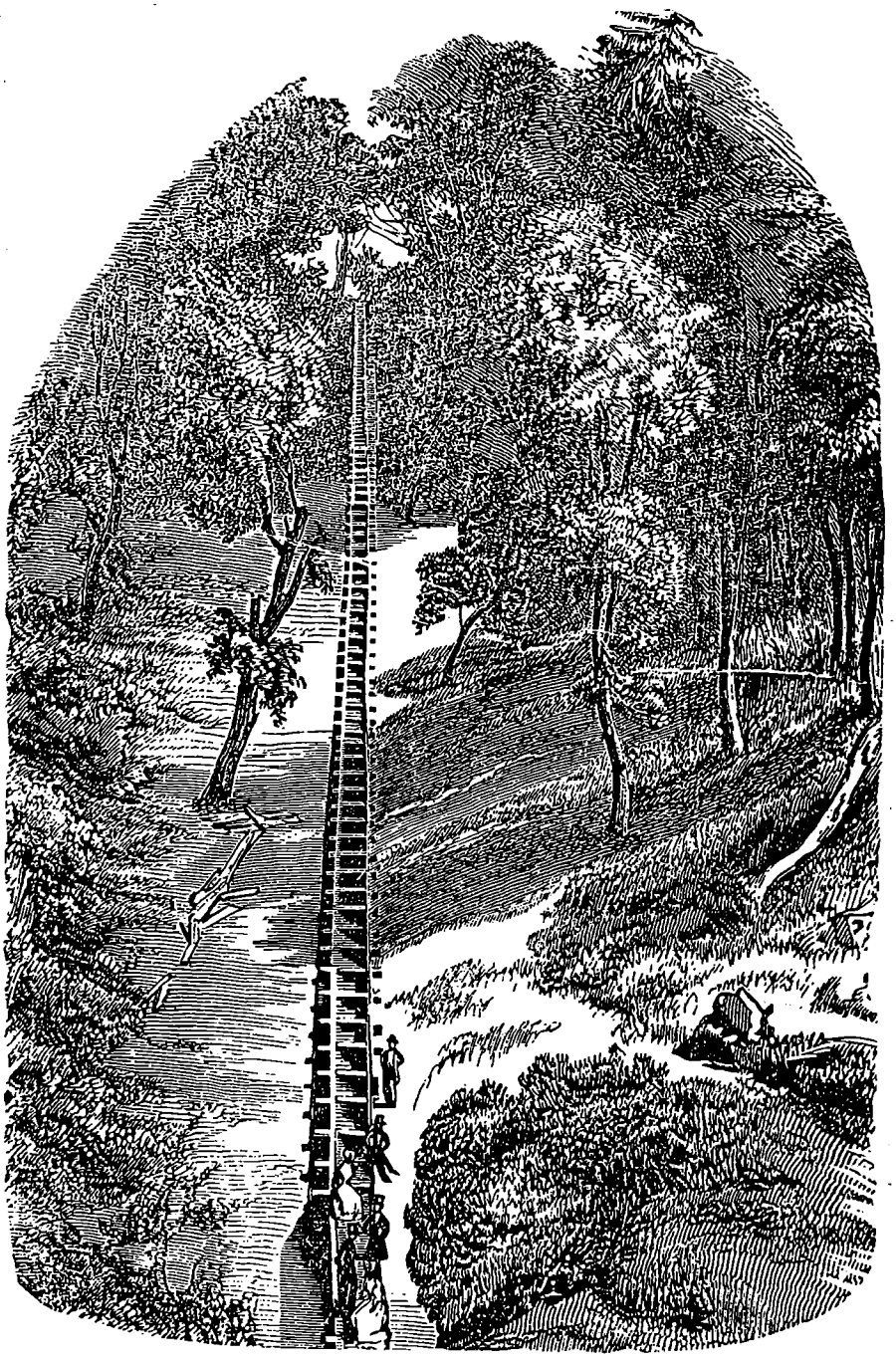
Just as California loggers were quick to recognize the advantages of steam-powered sawmills over water-powered ones, they also soon came to anticipate the benefits of steam power as a means of transporting the cut logs to their mills, and the finished lumber to market. Logging historians frequently suggest that the earliest logging railways in the United States were developed in Michigan in the 1870's, ignoring evidence from California which either predates them or is at least as early. Curiously, however, the first railroad built exclusively to serve a California logging effort predated the arrival of the first steam engine in the golden state by almost a decade.

J.M. Hutchings wrote of what surely was one of, if not the, first "Saw Mill Railroads" In California (Figure 14) in November, 1860. The operation was near Sly Park, on the North Fork, Cosumnes River, in El Dorado County, a part of California that still derives most of its income and employment from the timber industry. The railroad was built in 1852 so as to serve a sawmill that was built expressly to cut the lumber needed to build a "canal" (or flume and mining ditch) running from the Sly Park area downslope to Weberville and Mud Springs (present-day El Dorado City). Flatbed timber cars were loaded at the top of a ridgeline with logs skidded in by ox or mule; the sawmill lay 700 feet lower in elevation, and the "railroad" was said to be only 1000 feet long. Far from being steam-powered, the functioning of the "railroad" was entirely by gravity, and used a reciprocal method of switching (unhitching and re-hitching) unladen for laden flatbed cars at the top of the grade:

> "This railroad is built upon an inclined plane, at the (often quoted) angle of forty-five degrees, for the purpose of lowering saw-logs to the mill. The car descends with its load, and being attached by a rope thro' a pulley at the top to the empty car, the weight descending causes the empty car to ascend; by which contrivance the necessity of any other kind of machinery for that purpose is obviated."
>
> "At this mill was sawed all the lumber needed in the construction of the flume; besides supplying many thousands of feet of lumber, for sluice making and other purposes, in the settlements below" (*Hutchings' California Magazine*, Vol. V, No. 5, November, 1860).

Hutchings' woodcut shows conventional cross-ties and parallel rails but little else; presumably, like most early California mining "railroads" powered by mules or the miners themselves, the tracks were narrow gauge, perhaps 3 feet between the rails, and the rails themselves were wood, possibly surfaced with strap iron.

Figure 14: Gravity logging railroad in El Dorado County, California, built in 1852. Reproduced from Hutchings' California Magazine, Volume V., No. 5, November, 1860.



SAW MILL RAILROAD ON THE NORTH FORK OF THE COSUMNES RIVER.

The route of the first conventional, steam-powered railroad in California, reflected the economic focus of the state at the time of its initiation in late 1860. The line ran only 22 miles from Sacramento to Folsom, where it ended at the Placerville Road to the Nevada Silver Mines. Lumber cut in the higher elevations of El Dorado County was shipped by wagon to the railhead at Folsom, and then made the short trip to Sacramento where much of it was used in construction, or was loaded onto lumber scows at the Sacramento waterfront for the trip down the Delta and across the Bay to San Francisco.

The first steam locomotives in California were built in east coast factories and shipped around the Horn, taking up to 6 months to make the trip from coast to coast. This was despite the fact that the first ironworks on the Pacific Coast had

been founded in San Francisco by the three Irish Donohue brothers in 1849, who soon began to build steam boilers for ships, ferryboats, and stationary purposes, but whose facilities were unequal to the production demands of a full-sized locomotive. The Donohues added a foundary in 1851, so that castings, especially those of the hammers used in quartz mining stamp mills, could be produced. The Donohue's factory became the famous Union Iron Works, and by 1860 San Francisco had a total of 14 foundries serving the growing demand for steam boilers and stamp mills on the Pacific Coast (R. Dillon, 1984).

The second rail line in California, the San Francisco-San Jose railroad, was begun in 1861 by Peter Donohue, of the famous Union Ironworks, and completed in 1864. The line was finished just in time for a monumental event: the first steam locomotive built on the Pacific Coast, the *California*, was completed at the Union Ironworks in San Francisco within a year. This locomotive, weighing 29 tons, was a 4-4-0, standard gauge machine carrying 17 tons of water and fuel (R. Dillon, 1984). The lumber industry on the lower San Francisco peninsula at suitably named locations such as *Palo Alto* ("tall tree") and Redwood City obviously benefited from this new means of access to the port of San Francisco, where finished lumber was shipped all over the Pacific Coast and even west to the Asian mainland. Santa Cruz County, by 1865, had no fewer than 27 sawmills in operation, producing upwards of 270,000 board feet of lumber daily (McCrary, 1981: 6). A load of Santa Cruz Mountains lumber, loaded in a mule-drawn freight wagon at San Jose, might take up to two days to reach San Francisco, depending upon the condition of the roads, but with the coming of Donohue's "iron horse" after 1864, the trip was made in only two hours.

Almost overnight, timberland within easy reach of the rail line running along the eastern flank of the Santa Cruz Mountains jumped in value, and lumbermen set about trying to find ways to either build their own railroads, or persuade the railroad financiers to "bend the line" their way. A 39-mile extension of the San Francisco line, the *Santa Clara and Pajaro Valley Railroad*, was begun in 1868 and completed the following year, in order to reach Gilroy and tap the agricultural wealth of the Salinas Valley and the lumber of the Santa Cruz Mountains.

The major thrust of railway fever in California, however, was eastwards, with the goal of bringing California products to the great markets on the eastern seaboard. A California state railway commission met in 1859 so as to explore the best means of linking California with the rest of the country by rail, obviously with the intention of running a line from Sacramento through the Sierra Nevada into the Western Utah Territory, soon to be renamed Nevada. The commission had in hand various survey reports made by explorers such as Ebbetts and others, who had examined Sierran passes with an eye towards eventual rail construction almost a decade earlier. One year into the Civil War, in July of 1862, Abraham Lincoln approved the Pacific Railroad Act, which authorized two companies, one east, the other west, to begin building a transcontinental line towards each other. The eastern Company, the Union Pacific, was delayed by the Civil War, but in California, work began as early as 1863 on the most difficult part of the entire line: the Sierra Nevada.

Much of the work through the Sierra involved tunnelling, and new engineering methods borrowed from more than a dozen years of experimentation with mining applications made this work some of the most innovative in the world at the time. More than forty linear miles of snowsheds had to be built to keep the work parties, and later, the trains, from being buried in avalanches, and these, in combina-

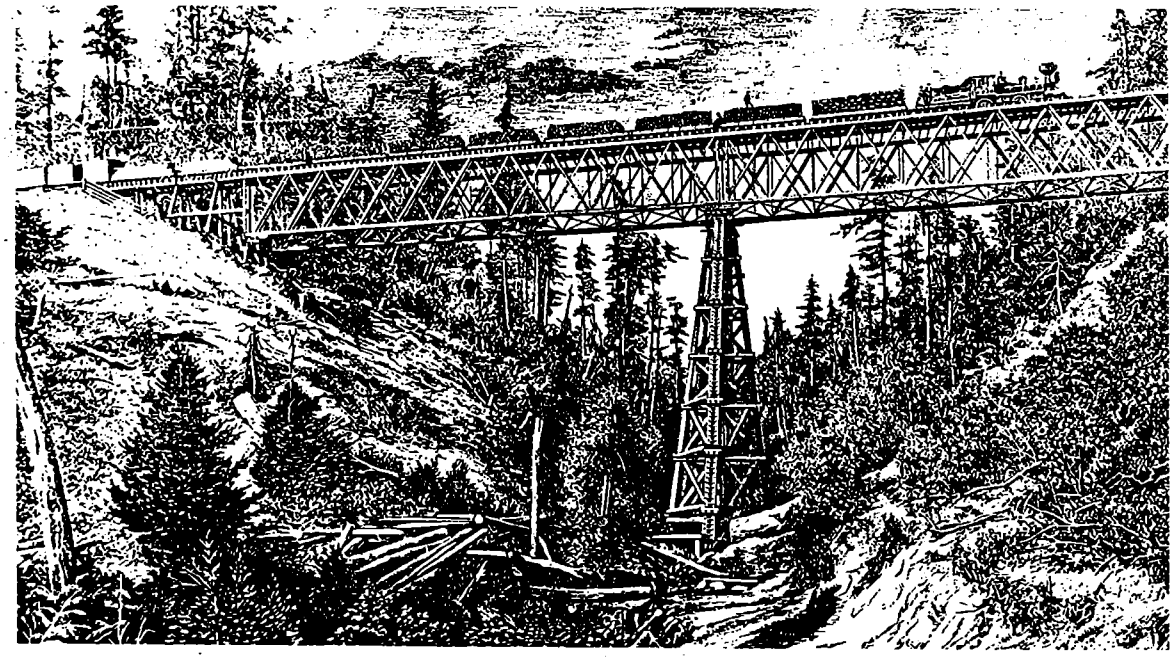


Figure 15: The Brown's Canyon railroad bridge near Occidental, Sonoma County, built for the North Pacific Coast Railroad (note lumber train crossing bridge) in 1876. For a while this was the tallest timber bridge in the United States; 300 feet in span, and 137 feet in height. From Dickinson, et. al., 1967: 36.

tion with the hundreds of trestles and millions of "sleepers" or railroad ties, led to a bonanza in the Sierra Nevada lumber industry. The first areas to be logged were those immediately adjacent to the rail line itself, but within short order the best and most accessible stands of timber were being harvested throughout the Central Sierra wherever they were found. By the time of the transcontinental railroad's completion in 1869, a large percentage of all the lumber cut in California was moving by rail.

Meanwhile, in the Redwood strip of the South Coast Ranges, the *Santa Cruz Railroad*, intended to link the lumber mills of the coastal communities with the rich farming zones of the Salinas Valley, was organized by local investors including F. Hihn and C. Spreckels after the Southern Pacific declined to extend its own route. The work began in December, 1873, at Santa Cruz, proceeding eastwards with Chinese labor working 6 ten-hour days a week at a salary of $24.00 per month, less $8.00 per month deducted for food (Lydon, 1985: 90-91). The line was completed in 1876: now timber from both sides of the Santa Cruz Mountains could reach the great shipping port of San Francisco directly by rail. Within a very short period of time, spur lines, such as the one running to Loma Prieta, would be built exclusively so that previously uncut stands of Coast Redwood could be converted to cut lumber and loaded on flatcars at sidings right next to the big, steam-powered mill.

North of San Francisco Bay, the *North Pacific Coast Railroad*, a narrow-gauge line with only three feet between the rails, began operations in 1875; like all California railroads of the period, the NPC was built by Chinese labor. The NPC, colloquially called "The Narrow Gauge to the Redwoods", crossed Marin County from south to north, and then headed likewise through Sonoma County so

Figure 16: View of Tyrone Mill, circa 1876, on Dutch Bill Creek in the Russian River redwood country, Sonoma County, served by the North Pacific Coast Railroad. From Dickinson, et. al., 1967: 39.

as to service the lumber mills on the Russian River at Duncan Mills (Dickinson, et. al, 1967). The line reached the timberlands of the Russian River Country in 1876, where it began servicing a number of sawmills at Moscow Mill and Duncan's Mill, the latter of which had been in operation since the 1860's. Prior to the coming of the railroad, milled lumber had been moved on a mile-long tramway to a landing where it was loaded on lumber schooners for the trip down the coast to San Francisco.

> "Less than a year following completion of the North Pacific Coast Railroad, half a dozen large sawmills began operations along the right-of-way and daily loaded their products on flat cars. These mills had a combined capacity of 175,000 feet of lumber per day plus great quantities of shingles, laths, pickets, cord wood, tan bark and charcoal" (Dickinson, et. al, 1967: 37).

The Russian River mills that sprang up in response to the new rail lines included Alexander Duncan's new mill, the Moscow Mill, Tyrone Mill (Figure 16), Monte Rio Mill, Streeten's Mill, and the Meeker Brothers Mill.

While all of these early railroads stimulated, and in turn, were stimulated by, the California lumber industry, the steam locomotives of the 1860's and '70's were not well-adapted to its peculiar requirements. Railroad logging, or at least log transport, required great amounts of low end torque so as to move the vast tonnages involved over frequently quite broken terrain, and standard "big-wheel" steam locomotives had neither the torque nor the gearing to be serviceable in steep mountain regions such as the Sierra Nevada and northern Coast Ranges.

A solution to the problem emerged in 1881, when Ephraim Shay, a Michigan logger, familiar with the shortcomings of standard steam locomotives in logging

contexts, designed a steam "loco" more suitable for logging. Shay locomotives were driven by worm gears rather than by large, exposed connecting rods, as were conventional steam locomotives. This propulsion method allowed for lower gearing, and, consequentially, much lower top speed than normal engines: about 15 miles per hour. But, torque rather than velocity was just what was required in railroad logging, and the Shay Locomotive seemed tailor-made for the steep grades and heavy loads of the California timberlands. The Shay could climb grades of almost 10% with its low gearing, and negotiate 30-degree curves because its worm-drive had universal joints which allowed the driven wheels to rotate slightly on their trucks. The Shay was built at the Lima Locomotive Works of Lima, Ohio, and between 1881 and 1945, 2761 such logging locomotives rolled off the assembly line.

An interesting study of railroad logging in California has been compiled by James Rock (1986), for Siskiyou County. Railroad logging got a comparatively late start here, in the 1890's, but by the 1920's Siskiyou County had no fewer than 31 different companies engaged in logging operations using steam locomotives. The *Weed Lumber Company* stood head and shoulders above all others in the county: at peak, it had 13 logging locomotives and more than 500 miles of spur line logging track laid down in the woods.

Perhaps the best single study of railroad logging in California is that by Polkinghorn (1984) of the *Michigan-California Lumber Company's* operation in El Dorado County, centered around the mill at Pino Grande. First begun in the early 1890's by Colonel George Cummins as a project of the *American River Land and Lumber Company*, railroad logging on the Georgetown Divide lasted for almost 60 continuous years. The earliest rails for the narrow-gauge track were alternatively said to have been bought surplus in San Francisco, where they had been used to support cable-cars, or to have come from the old Sacramento-Folsom line, the first in the state. The first tracks laid ran down to the great log chute at Slab Creek; like the earliest El Dorado County logging railroad of 1852, the early 1890's version was also gravity-propelled, with the empty cars being pulled back up the grade by teams of horses. By 1892 the first small (25-ton) steam logging locomotive had arrived on the Georgetown Divide, and Colonel Cummins had up to 250 men leveling the grade for the railroad tracks heading through the woods.

By 1898 a second small locomotive had augmented the rolling stock of the operation, but the company went bankrupt in 1900 and the first "loco" had to be sold. Reorganized as the *El Dorado Lumber Company*, the railroad logging operation grew by leaps and bounds, and a great mill was built at Pino Grande, itself consuming no fewer than 250,000 board feet of lumber in its construction (Polkinghorn, 1984: 23). Another mill was built at 7 mile house (seven miles up the grade from Placerville) in 1901, and shortly afterwards the locality was renamed *Camino*. A narrow-gauge line was built from the mill at Camino to Placerville, where it was to meet a spur of the main rail line, and by 1902, the narrow-gauge line had been extended from Camino up to the great cable bridge over the American River gorge near Slab Creek (Figure 17). In 1904 the Placerville and Lake Tahoe Railroad line, a standard-gauge route, was completed, so that lumber from the Camino planing mill could be loaded directly onto standard-gauge flatcars and shipped anywhere in the country. By 1905 the El Dorado Lumber Company was producing up to 225,000 board feet of lumber daily, and the town of Camino, essentially a milltown owned by the company and populated by its employees, numbered 500 people.

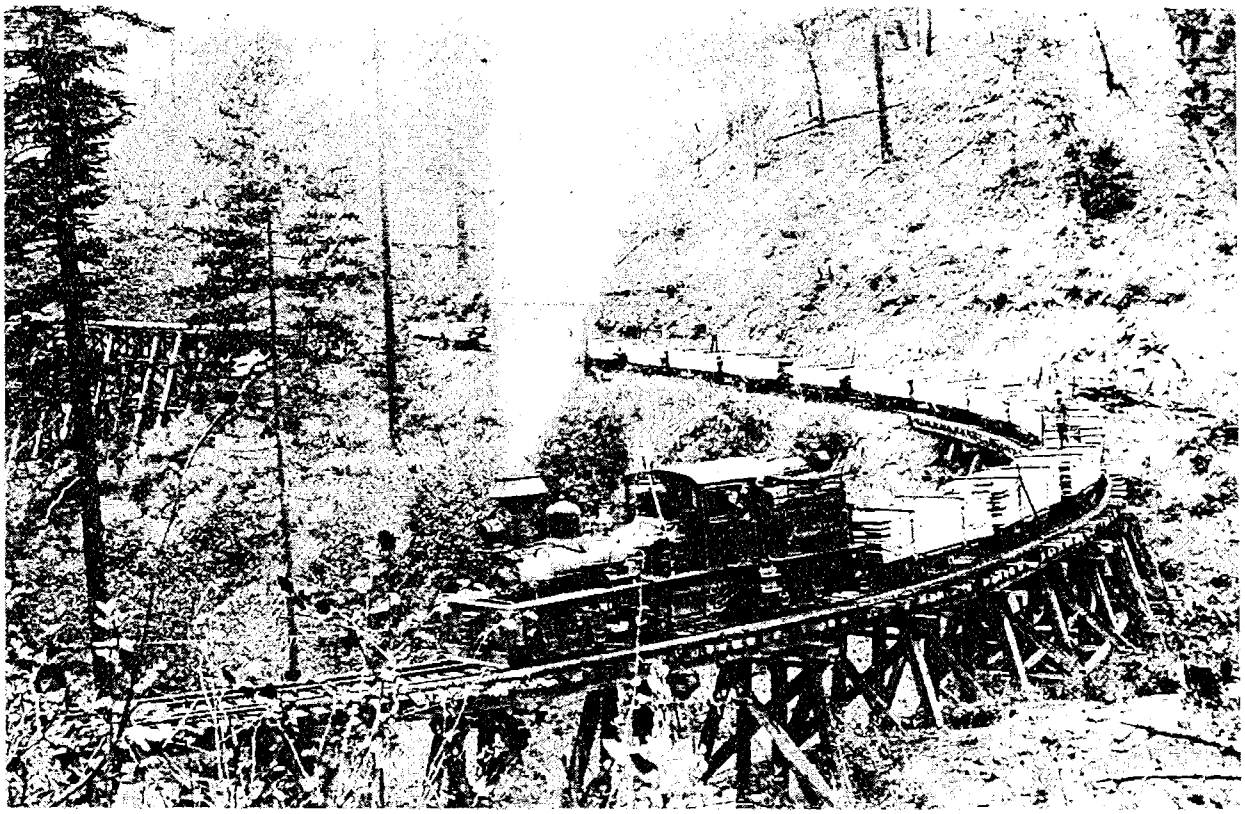


Figure 17: The El Dorado Lumber Company's Engine No. 5, a 25-ton Shay built in 1903, hauling a load of lumber from the Pino Grande sawmill to the great cable over the American River. Reproduced from Polkinghorn, 1984: 95.

A financial panic in 1907 led to the bankruptcy of the *El Dorado Lumber Company*, and after some years of turmoil, the operation was taken over by the *C.D. Danaher Pine Company*, then again by John Blodgett, who formed the *Michigan-California Lumber Company* in 1918. Blodgett revitalized the lumber industry on the Georgetown divide, and under his guidance the railroad logging operation grew to its greatest extent, with hundreds of miles of track and dozens of trestles, both large and small.

Michigan-California operated at least one, and sometimes two, camps each logging season, which normally lasted from May to November. Each camp incorporated more than 150 men, a dozen logging crews, a half-dozen steam donkey crews, and separate grade, railroad, and bridge crews to keep the rail line going. An innovation peculiar to the railroad logging method was the movement, sometimes overnight, of "portable" logging camps. As early as the 1860's in California, construction crews working on the transcontinental railroad were living in special dormitory cars that kept pace with the extension of the line, but such accommodations would be ill-suited to the constantly-moving logging operations for they would tie up rolling stock that could be better used elsewhere. The solution arrived at was the movable camp house (Figure 18). These simple structures were mass-produced, and housed four employees each. They could be loaded on railroad flatcars, transported to whatever camp seemed most appropriate for that season's logging effort, then moved on to the next camp or back to the millyard for storage during the winter months when snow shut down the operation.

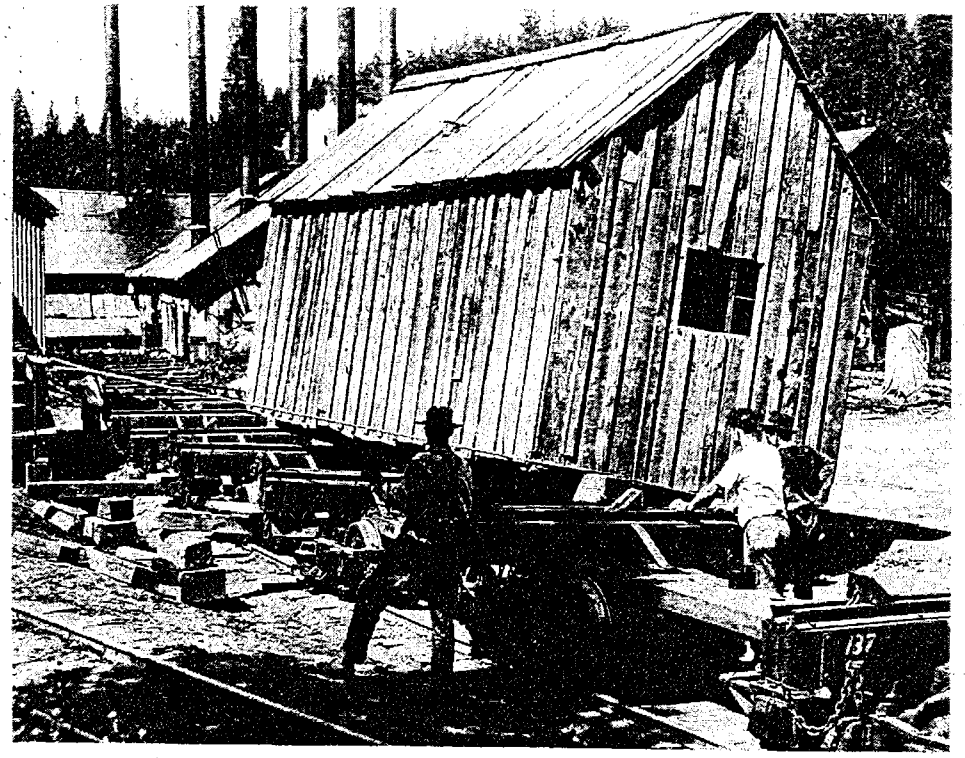


Figure 18: Portable logging camp house being loaded on narrow-gauge flatcar at the Pino Grande mill prior to being sent into the woods in the early 20th century. Reproduced from Polkinghorn, 1984: 106.

Some 21 different locomotives were used on the Georgetown Divide between 1891 and 1951, when the operation finally ended. Polkinghorn (1984) in a remarkable piece of scholarship has assembled the vital statistics and brief "biographies" of each one of these engines, including their ultimate fates. Three of these engines remain in Camino, a Shay, a Porter, and a Vulcan. Another of the old Shay engines of the Camino, Placerville and Lake Tahoe Railroad is preserved in Los Angeles' Traveltown Museum in Griffith Park, in essentially the same shape as when it pulled its last load of lumber down through the Sierra.

Logging Flumes

The most spectacular and perhaps unique technological innovation in the history of the California lumber industry was the flume logging operation developed in the southern Sierra Nevada. Long-distance logging flumes were an innovating answer to that most common of timber industry problems; separation of the market from the source of supply. In the southern Sierra of Fresno, Tulare, and later, Madera, Counties, the distribution network and ultimate market for lumber lay some 40 to 80 miles away from the prime timber that might be profitably harvested. The traditional solution to this situation would be to operate a mill where the trees were and then ship the finished lumber at great expense down to the San Joaquin Valley and coastal strip, where the market for it existed. Instead, the reverse was tried with resounding success. Lumber was only rough cut in the mountains, and finishing mills were built on the San Joaquin Valley floor at existing railheads; the logs came hurtling down the flumes to land at the mills dozens

of miles away from where they were cut. Millions of board feet of lumber were processed in this fashion during the last quarter of the 19th century, and the method became so successful that it led to the formation and naming of an entire city and California County: *Madera.*

One of the earliest flume logging enterprises was developed by the *California Lumber Company* in northernmost Fresno County. Its flume was built in 1874, and had a length of 63 miles, reaching from the valley floor, where the railroad had gone through in 1870, into the high Sierra. The construction effort $500,000.00 to build, and incorporated 5 million board feet of lumber and 2,100 kegs of nails. In 1876, at the end of the flume, the company laid out its milltown, which it named *Madera*, or "wood". The lumber town of Madera soon became the focus of some of the most productive lumbering in California. The *Sugar Pine Lumber Company* and the *Madera Sugar Pine Company* together had a monthly payroll of $140,000 in the 1870's, and employed up to 1,000 men at a time (Hoover, et. al, 1990: 170): both were eventually taken over by the *Madera Flume and Timber Company.* Finally, in recognition of the lumber industry's contribution to the local economy, in 1893 a new county was formed through secession of northernmost Fresno County, and was named Madera, after the boomtown which became its county seat.

Meanwhile, to the south, similar flume logging operations were being developed in Fresno County. Perhaps the most famous of these was built in the Kings River drainage, eventually becoming known as the "Hume Flume", the planked conduit of the *Kings River Lumber Company* which terminated at its mill in Sanger. The flume carried logs 10 hours a day and had a daily capacity of 250,000 board feet. The Hume Flume grew from 54 to 73 miles in length, the longest and largest such flume in the world (Vandor, 1919: I, 160; R. Dillon, 1988b). In 1885 or 1886, H.C. Smith and A.D. Moore formed the *Kings River Lumber Company*, taking over an old mill on Abbott Creek and making it their lower mill, and building their upper mill at Millwood. From Sequoia Lake they built a flume down the south side of Mill Flat Creek to the lower mill, which, in symbiotic fashion, produced the lumber for the flume's construction. From there, the flume dropped down the canyon of the Kings to Trimmer Springs, then descended an elevated incline to cross to the north bank via a high structure atop the suspension bridge there. The wooden "ditch" then paralleled the river, on high trestles, for several miles beyond Centerville before finally terminating at Sanger (McGee, 1952: 9-10).

The *Kings River Lumber Company* flume was built of wood, with a flat bottom and sloping sides. Henry McGee, an Orosi contractor, superintended its construction. The flume took bundles, called clamps, of lumber about a foot square and 18 to 20 feet long. Oversized lumber and "choice" wood, which could bruise in chuting the flume, was sent down by wagon. Iron clamps and wooden wedges kept the bundles together. "Herders" hitched three bundles together to form a train in the lazy water of the Upper Mill's flat. This shot down cascade-like inclines and across trestles 60, 85, and even 108 feet above the ground (which, itself, dropped away into a 500-foot gorge), and then along cliff faces where the flume hung suspended in mid-air (McGee, 1952: 9-11).

In the level places at the Lower Mill, Camp Number Three (Rancheria Creek) and Camp 4 1/2 (Cow Flat), the flow would again slow and "herders" would attach additional clamps of bundles to the train until, at the Sanger lumberyard, it would be enormously long. From fifteen stations or camps along the flume, where water slackened its pace, "flume snakes" (flume tenders) patrolled the wooden ditch

from a catwalk that was a part of it. Each carried a tool called a picaroon to loosen lumber jams. It was invented by a man with the unfortunate name of Bowell, according to Lizzie McGee. Lumber company blacksmiths, like Buck McGee, made picaroons out of double-bitted axes. One bit of the head was slightly reshaped and the other was transformed into a curved point. A telephone line connected the two terminals of the flume with the stations along the way. Jimmy Mansfield of Centerville was superintendent of the flume crew. Only one "flume snake" (A.J. Denenbark), ever fell to his death from the high trestle at Trimmer, but several builders of the flume lost their lives in falls (McGee, 1952: 11).

The flume lost so much water on inclines, from slopping over the edges, that feeder streams such as Rancheria and Cow Creek were tapped to replenish the flow from Millwood's Sequoia Lake. At the lumberyard in Sanger, the bundles were slid off and piled up to dry before finishing in the milling plant (McGee, 1952: 11-12). Two kinds of boats were used in the flume, providing thrilling and often dangerous travel. A long boat conformed exactly to the slanting sides of the trough. Another, more stubby, craft was call a dinky. It was braced underneath with two "Vees" and took two men, tandem like canoeists, with feet braced and, since there were no handrails, their (white) knuckles on the tops of the sides. The boats were used by company inspectors, supply crews, and by others in emergencies. A doctor once rode one down at night, and a nurse and expectant mother also made the hair-raising trip (McGee, 1952: 12-13).

Supplies were freighted up to Millwood from Sanger, and then floated down to points between there and Maxon's Ranch and Trimmer Springs. On steep inclines, the flume boats, moving at 50 miles an hour, sometimes outran the flow of water and grounded in the flume and turned over. Two men with suitcases survived such a turnover. They righted their boat and continued on to Rancheria Creek Station, where their floating baggage had been fished out. The trip down to Trimmer usually took 5 to 6 hours. Most passengers left the uncomfortable boats there and transferred to a stage to Sanger since the boats made only four miles per hour after Pine Flat. Boats, iron clamps, and so forth were returned to Millwood, and later Hume, by wagon (McGee, 1952: 11-12).

Since lumbering was big business by end of the 19th century, next only to agriculture in Fresno county, it was only natural that it should gravitate into the hands of a few large companies. Around 1907, George Hume and his partner, Bennett, with Michigan money, took over the old Kings River Lumber Company and renamed it the Hume-Bennett Lumber Company. They put in a new mill on Ten Mile Creek where they created Hume Lake by damming (1908) and moved the main mill (earlier transferred from logged-off Millwood to Converse) to Hume by 1909. They built a steep new flume down the hillside adjacent to the rapids of Ten Mile Creek, and then down the Kings to its junction with Mill Flat Creek to connect with the old flume. The new water pathway was much steeper and costlier. One trestle was 185 feet high, and there were stretches along rocky cliffs. Each year, a million board feet was said to be used just to repair the flume, now 73 miles long. Several workers again fell to their deaths, one man toppling 85 feet into a bouldery canyon (McGee, 1952: 18-21).

The Ten Mile Creek stretch of flume was so steep that it was never full of water and few men dared ride it. John Perry, constable at Hume, tried it in order to serve papers on someone on the line, but near Camp 1 1/2, the boat upset and he was badly battered. He had to spend three weeks in bed with cuts, bruises, and probably fractures. The last man to ride it was Buck McGee, going down to the

Kings for a bit of fishing. According to Lizzie McGee, he was glad that the flume's dismantling removed temptation to try it again, although he bragged that the worst part was the hike back up the hill. Once a bad lumber jam, far down toward the Kings, caused a rupture in the flume in an inaccessible spot. Lumber piled up in the steep creek bed, never to be salvaged, until loading was stopped from above (McGee, 1952: 21-23).

The old Kings River Flume, after 1907 commonly called the "Hume Flume" after one of its new owners, was not the only one to bring the timber treasure of the Sierra Nevada to the San Joaquin Valley floor. Clovis, today more a Fresno suburb than a town in its own right, owes its existence to a second flume, built by L.P. Swift and C.B. Shaver's *Fresno Flume and Irrigation Company*, constructed to take advantage of Pine Ridge Lumber. The Toll House Grade, leading to the timber-rich Pine Ridge of Fresno County, was said to be the second-steepest in the state at 33 degrees in some places, was so hard on teams that it was called the "beast-killing grade." Vandor wrote, for example, "So fearful is the grade that passengers by stage were cajoled, threatened or commanded to walk it to relieve the jaded animals in the ascent." Yet, heavy railroad car wheels, track and a small logging locomotive were hauled up it to the Fresno Flume and Lumber Company at Shaver Lake. And the toll road opened up not only mills 10 miles up at Donahoo, but the back country of Dinkey Creek, the Big Trees, the miniature Yosemite of Tehipite Valley, and Kings River Canyon (Vandor, 1919: 100; Memorial, 1892: 72; R. Dillon, 1987).

Both lumbermen hailed from Michigan. C.B. Shaver, born in 1855 in Steuben County, New York, moved to Michigan as a boy and was lumbering by the time that he was 19. He married Lena Roberts in 1883 after resigning as woods foreman in order to start building logging railroads and mills in Michigan and Missouri. Swift, born in Perry County, Indiana, was a self-made man with only a common school education. In 1892 Shaver came to Pine Ridge and became the key factor in the success of the Fresno Flume and Irrigation Company, which had been organized earlier. He bought an interest in the firm and took charge of the survey and construction of the 40.25-mile long flume (some sources say 42 miles) from Stephenson Creek's 60-foot-high dam to Clovis, which required 9,000,000 feet of lumber and cost $200,000. Charles Shaver moved in heavy equipment to build a dam in 1892 on Stephenson Creek, which flooded Stephenson Basin into a big mill pond that is today the heart of Shaver Lake. This fed the 40-mile flume to Clovis, which was operating by 1893. The flume brought out more lumber in one season that all of the other mills except, perhaps, the Herman Peterson Mill (The old Smyth and McCardle Mill) which was then run by a stock company (Vandor, 1919: 100, 159-160; Winchell, 1933: 83-84).

Swift had ran lumber mills at Cheboygan, Michigan, and Quincy, Illinois, before coming to Pine Ridge a year after Shaver, in February of 1893 to erect his eighth mill, with the latter's help, 60 miles east of Fresno. He brought along 30 Michigan families of mill and lumberyard workers. At Shaver, Swift erected houses, a school, and a store. It took two years to complete the mill there, but production grew until by 1919 its 500 employees were working it at a capacity of 40,000,000 board feet a year. The place was named for the first of the two partners, *Shaver*. Swift was named first postmaster when the third-class office opened on August 1, 1896. It was discontinued on October 31, 1925 and moved to Big Creek, but re-established as Shaver Lake, a summer-only post office, on February 3, 1928 (Vandor, 1919: 740; Salley, 1971: 202).

At the other end of the line, the flume dropped its loads of lumber about where the Rodeo Grounds and the C. Todd Clarke Intermediate School are located today. Swift established planing mills, drying kilns, a box factory and a huge lumber yard at Clovis, from which products were shipped via the Southern Pacific Railroad for local consumption and to ports for worldwide distribution. He also invented a hard-working log-turning machine. By 1897 Clovis had 500 inhabitants, including 140 mill workers, a school, several churches, hotels, restaurants, a handsome rail depot, grain warehouses, a post office, and an express and telephone office, all, besides the original Fresno Flume and Irrigation Company, on the original 40 acres of town lots. There was train service to Fresno, and Pollasky/Hamptonville (now Friant), both 10 miles away, and daily stage service to Fresno. In 1898, the 40-acre mill plant burned to the ground, but it was rebuilt and the lumber company continued to dominate the town for many years more. Clovis quickly metamorphosed from railroad town to lumber town as the Fresno Flume and Irrigation Company, later the Fresno Flume and Lumber Company, completed its 42-mile flume from Shaver to a terminus on the S. P. line at Clovis. The latter became not just a lumber town, but a "flume town," like Sanger and Madera. The 12 miles of logging railroad around Shaver and the steam towboat on the big millpond fed some 35,000,000 board feet of lumber a year into the flume (R. Dillon, 1987).

The *Fresno Flume and Irrigation Company* revolutionized logging on Pine Ridge by using chutes and flumes, miles of steel cable to drag in logs attached to winches and donkey engines, electricity for power, a logging railroad with a geared locomotive, and even a little steamer--a tug--to tow logs on the big mill pond that later became Shaver Lake. Harum-scarum types rode the flume in a specially-constructed craft, a trough-shaped shell, for a hair-raising trip down to Clovis. Daily capacity of the Shaver to Clovis operation was 200,000 board-feet in its pre-World-War I heyday, before L. P. Swift and his associates sold out, via Ira Bennett, to other Michigan capitalists. After 20 years of logging, the owners sold out. The new proprietors transferred the property to Southern California Edison Company, which cleared all remaining timber from around Stephenson Creek and enlarged the mill's reservoir into today's Shaver Lake by a bigger dam and power house (Winchell 1933, 84). In 1919 the year's output of Pine Ridge was between 60-75,000,000 feet of lumber, including some 5,000,000 in shakes and shingles, and box and tray wood for agriculture (Vandor, 1919: 161). As late as 1919 the lumber company payroll was $450,000 in Clovis, a town of 1,500 people. Lumber, in all, was worth $2,000,000 per year to the county, of which the Pine Ridge output equaled about the rest of the state's total (Vandor, 1919, I: 161; R. Dillon, 1987).

Many other logging flumes were built in California; one of the most famous was that of the Diamond Match Company which ran for many miles around the base of Mount Shasta. While not flumes in the sense that water running down them carried the logs, some very long (dry) log chutes were engineering marvels in of themselves. The longest such dry chute ever built in California, and perhaps on the Pacific Coast as a whole, was built by the American River Land and Lumber Company in 1893, in El Dorado County (Polkinghorn, 1984: 13). The wooden chute ran for more than a half-mile, 2,900 feet in all, dropping more than 1,100 vertical feet from a ridgeline into Slab Creek, a tributary to the South Fork of the American River: it took a sugar pine log only 30 seconds to "smoke its way" down the chute.

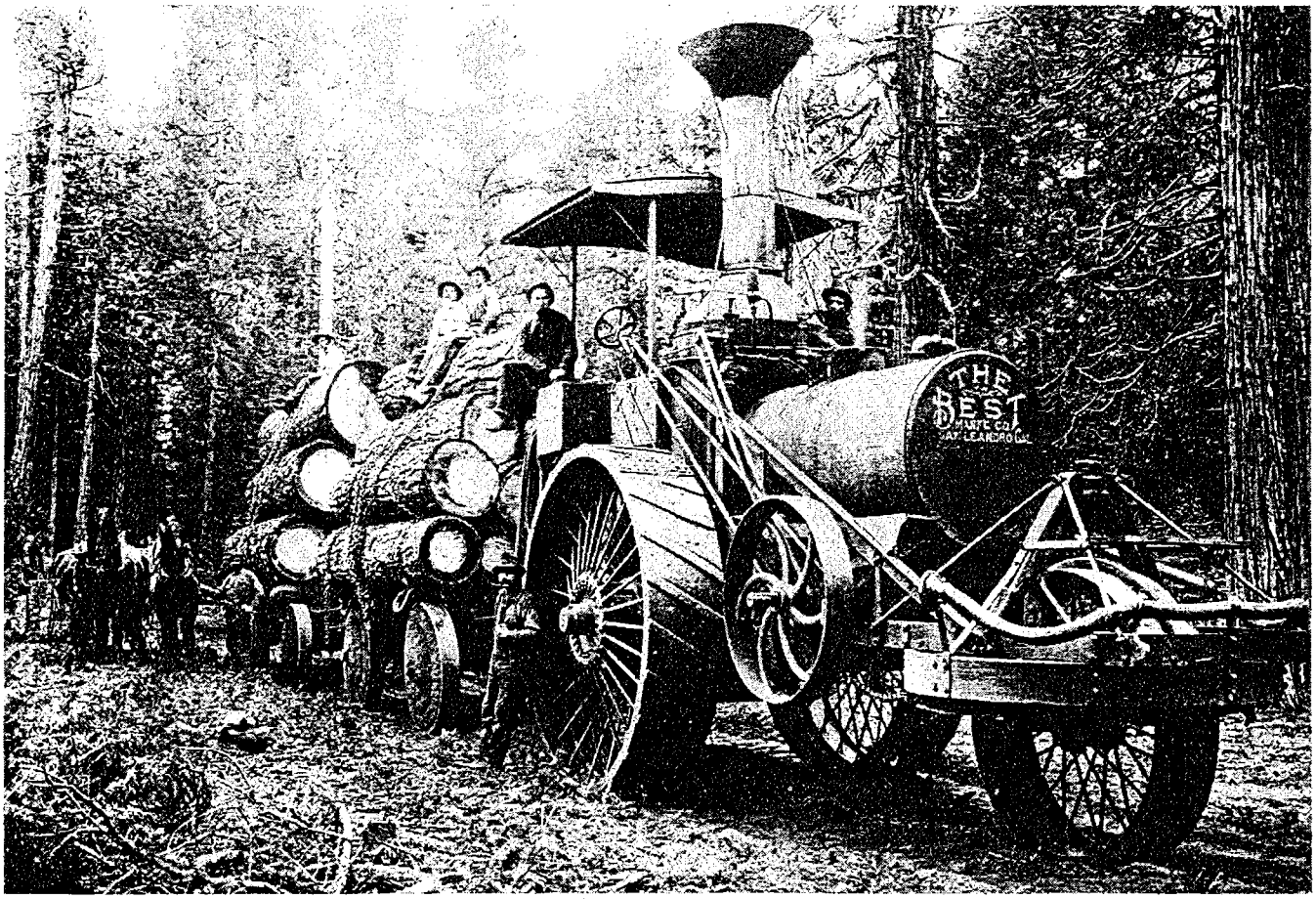


Figure 19: Steam traction engine used by the McCloud River Lumber Company, circa 1894, to haul pine log lengths on solid-wheeled carts. Reproduced from Andrews, 1956: 139.

Steam Traction Engines

John W. Humphreys' trusted partner, Moses Mock, drove the first steam wagon up the treacherous Tollhouse Grade in the Sierra Nevada of Fresno County. He made it safely the first time, but lost it off the road on a second trip. The Pennsylvania-born mechanic was associated with Humphreys off and on for 30 years at Tollhouse and Pine Ridge. He was the local inventor, with a workshop near Humphreys Station. He dreamed of building a steam-powered horseless carriage capable of making 10 miles per hour. He built a small model which worked well, but his larger one failed. He sent plans to a factory back east for an estimate of the cost of building the prototype. The cost was prohibitive, but the factory soon took out a patent on a very similar "steam wagon."

In 1886 Mock sent back east for an "off the shelf" steam traction engine: it cost $555.75 and almost as much again in freight. This early steam-powered logging "tractor" was used in 1887 at the Bradford and Morrow Mill near Sentinel, and in 1888 Mose Mock ran the contraption successfully up the Tollhouse Grade. Mock tried using it to pull logs at the Bonanza Mill, but, too underpowered in terrain too rugged, it failed at the task. Mock rescued the patented steam wagon after it tumbled off the grade and sold it to Clovis Cole, after whom the Fresno County

town of Clovis was named, but it was a failure on the latter's wheat farms, too. Cole in turn sold it to the Fresno Vineyard Company, which sent it to North Fork under its own power to haul wood. It was lost from sight after that and its fate is unknown (English, 1970: 30-31).

Another attempt to use steam traction engines in southern Sierra Nevada logging was tried by the *Kaweah Co-operative Commonwealth*, with a similar lack of success. A Ventura farmer who joined the colony, Irvin Barnard, brought his Farquhar "Ajax" steam traction engine with him, probably in 1888, so as to get cut lumber from the Colony Mill to the "town" of Kaweah in the high Sierra of Tulare County. Around 1891 or 1892, Barnard set up a sawmill, planer, and shingle mill just south of the bridge across the South Fork, to cut alders and sycamores. In crossing the span, the heavy engine broke through and was in the water for 3 weeks. Somehow, it was fished out by Alby Martin and A. E. Redstone with the help of a six -horse team; but when it was being ferried across the (main) river, the cable on the current-propelled boat broke. Flatboat and cargo ended up on an island downstream. Rescued once more, the heavy steam traction engine promptly collapsed the next bridge it was driven across. In 1895, Barnard sold his unlucky engine to Mrs. Adelle Curtis, who moved it back to the South Fork to cut alders. A. C., Mac, and J. Smith Dungan operated it, with Ben Southward, but alder is such poor wood that the venture failed. J.W. Kyle of Springville later bought the contraption. While being driven up the old Frazier Grade to Mountain Home's Enterprise Mill, its brakes failed, and it rolled several hundred yards towards Coburn's Dump and was smashed to pieces: the wreck was sold as scrap iron (R. Dillon, 1988a).

Steam traction engines presented the same problems in California as did "high wheel" logging: they needed level ground to function properly, and only trees with comparatively small diameter trunks could be moved by them. Where such conditions existed, they were put to effective use. In north-central California, near the Oregon line, where we have already seen the Michigan Big Wheels serving with few drawbacks, steam traction engines were also used, sometimes side by side with horse or ox teams (Figure 19). Steam tractors had been so improved by 1900 that they were used to good effect in the construction of the narrow-gauge railroad servicing the Pino Grande Mill in El Dorado County. These great steam traction engines were made by the Holt Brothers in Stockton, and specifically designed for the special problems inherent in California (Polkinghorn, 1984: 25).

Steam Donkeys and Cable Logging

While steam-powered mills were built in California as early as the 1840's, it was not until 40 years later that steam donkey engines began to replace oxen and mules as a means of getting cut logs from the felling site to the sawmill, or to the railroad tracks leading to the mill. Donkey engines, whose steam-powered "spools" winched logs on chains, then ropes, and finally on cables, began to replace bull teams in California as early as 1882 or 1883. This delay was not due to limitations of steam-engine technology, but to the comparatively late invention (and high cost) of steel cable, without which a portable steam donkey engine is simply so much dead weight. Braided or twisted flexible steel cable of a strength capable of pulling logs weighing many tons was developed, as one might suspect, not for the logging industry, but for naval and bridge-building applications.

Steel cable used in ship rigging did not become widespread in the United States until the late 1870's, and accidental breakage still resulted regularly in death or

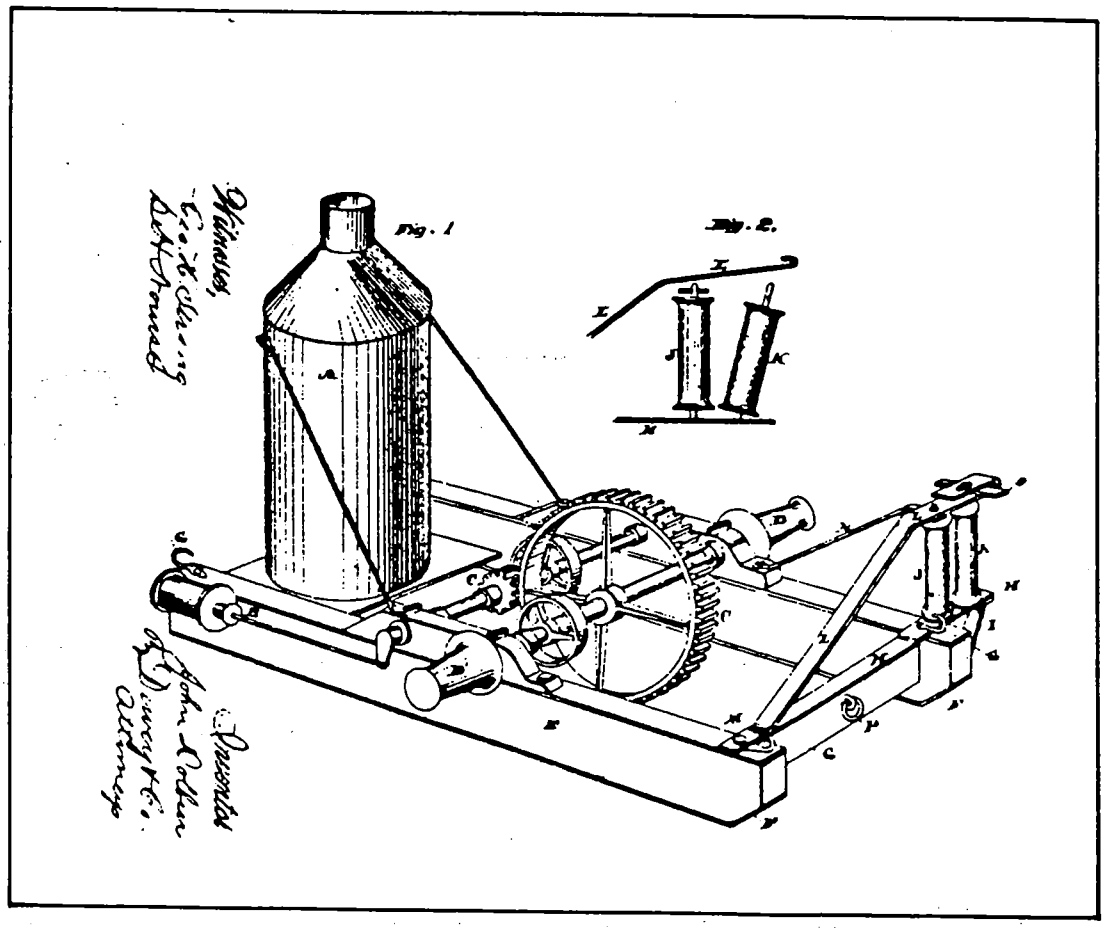


Figure 20: The patent sketch for John Dolbeer's steam donkey engine, 1882. From MacKay, 1978: 171.

dismemberment. The Brooklyn Bridge, begun in 1869 but not completed until 1883, was designed by the man who had invented steel cable some years earlier. This bridge was the first great structure to make use of steel suspension cable, and was reckoned as experimental in every way until the day it opened. Its success gave an immense boost to the steel cable industry.

Steam Donkey engines were not only first used in California, but were California inventions as well. John Dolbeer was an ex marine engineer who had turned to logging in the Eureka area in the 1870's with a partner, William Carson, of New Brunswick, Canada. Dolbeer adapted a small ship's steam engine used to power a winch while afloat to a similar function ashore, and the first steam logging donkey engine was born. Dolbeer's patent was taken out in 1882 (Figure 20). It had a skid-mounted vertical boiler, unlike the much larger horizontal boilers on steam locomotives, a single-cylinder engine of small size powering horizontal takeup spools on opposite ends of a live axle driven by direct gear from a primary drive axle. The name "donkey" engine had been coined in maritime use, in contrast to larger and more powerful "horse" engines (MacKay, 1978: 170). The first Dolbeer engines were very low-powered and designed to be used with manila rope. Only logs of comparatively small size could be moved with these contraptions, as the rope would stretch and/or break if overstressed by too heavy a load, or the steam donkey simply would not pull it. Furthermore, manila rope could only be used to lengths of around 500 feet, and the limitation of the system soon was obviously the line rather than the motive force powering it.

By the early 1880's refinements in steel cable manufacturing led to a drastic drop in its cost, and it began to be commonly used throughout the western US in logging operations in conjunction with skid-mounted, portable donkey engines. While Dolbeer's product was the best known, many other manufacturers produced steam donkey engines. All early versions were normally single-cylinder affairs, nothing more than glorified winches that were bolted to heavy skids made of log lengths which were in turn chained or cabled to a number of nearby living trees or large stumps. These "anchor" trees normally were selected in a kind of fan much wider than the maximum width of the donkey skid, the skid itself being at the apex of the triangle or "fan" made by the anchor chains or cables.

Turning points were made by hanging large cable blocks on other stumps or living trees "down the line", and individual cut log lengths could either be "cabled up" directly or have a similar quick-release block cleated to them for pulling along on a continuous loop. When an area had been logged off, the donkey engine's skid was disconnected from its anchors, and the apparatus was self-propelled via its own winch and cable, anchored to trees or stumps en route to the newly-selected cutting location.

Improved versions of the Dolbeer engine used vertical takeup spools or capstans with an improved drive system with lower gearing; if the boiler and engine developed the same amount of horsepower as earlier engines, through the new gearing and spool system more torque was available with which to overcome the inertia of the large log loads, and the Dolbeer steam donkey now became a very effective logging tool for ground-leading logs from the pickup landing to the drop-off landing.

> "Within a few years [of Dolbeer's patent] David Evans had invented a more powerful version, called a Bull donkey, bolted to great sled-like logs and powered with a 10-foot boiler topped with an iron smokestack and with gears and drums. They reeled in logs like whales on a harpoon line while the donkey bucked and shuddered and belched. . .The 'donkey puncher', or engineer, spent half his time, it seemed, tightening bolts with a monkey wrench" (MacKay, 1978: 170).

The old ox or mule-pulled logs had been cleated and chained to the harnesses for pulling; now, steel cable was simply looped around the log end a few times by the choker setter and terminated in a loop a short distance ahead; the end of the donkey engine cable was simply hooked through the loop, and the log hauled right up to the donkey where some slack was introduced into the line, the hook was pulled out, and the hook from the next donkey up the line placed in the loop. The donkey line was then pulled back to the log landing by the "line horse", more often than not a mule, and the choker setters then hooked up a new log and the process was repeated. Eventually even this draft animal was eliminated by the addition of a second spool on the donkey carrying a "haul-back" cable which would be linked to the pulling cable via a block or return pulley anchored to a dead man at the landing logs were being pulled from, forming what essentially became a "continuous loop" of cable (Figure 21).

With improved donkey engines and steel cable, the limitation now became not the weight of the log, but the weight of the cable and the space available on the spool to reel it in. To overcome these problems on long hauls, several donkey engines were placed in line, each with a cable ending in a open hook so that a log or string of logs could be quickly hooked or unhooked at various stages in the line. An

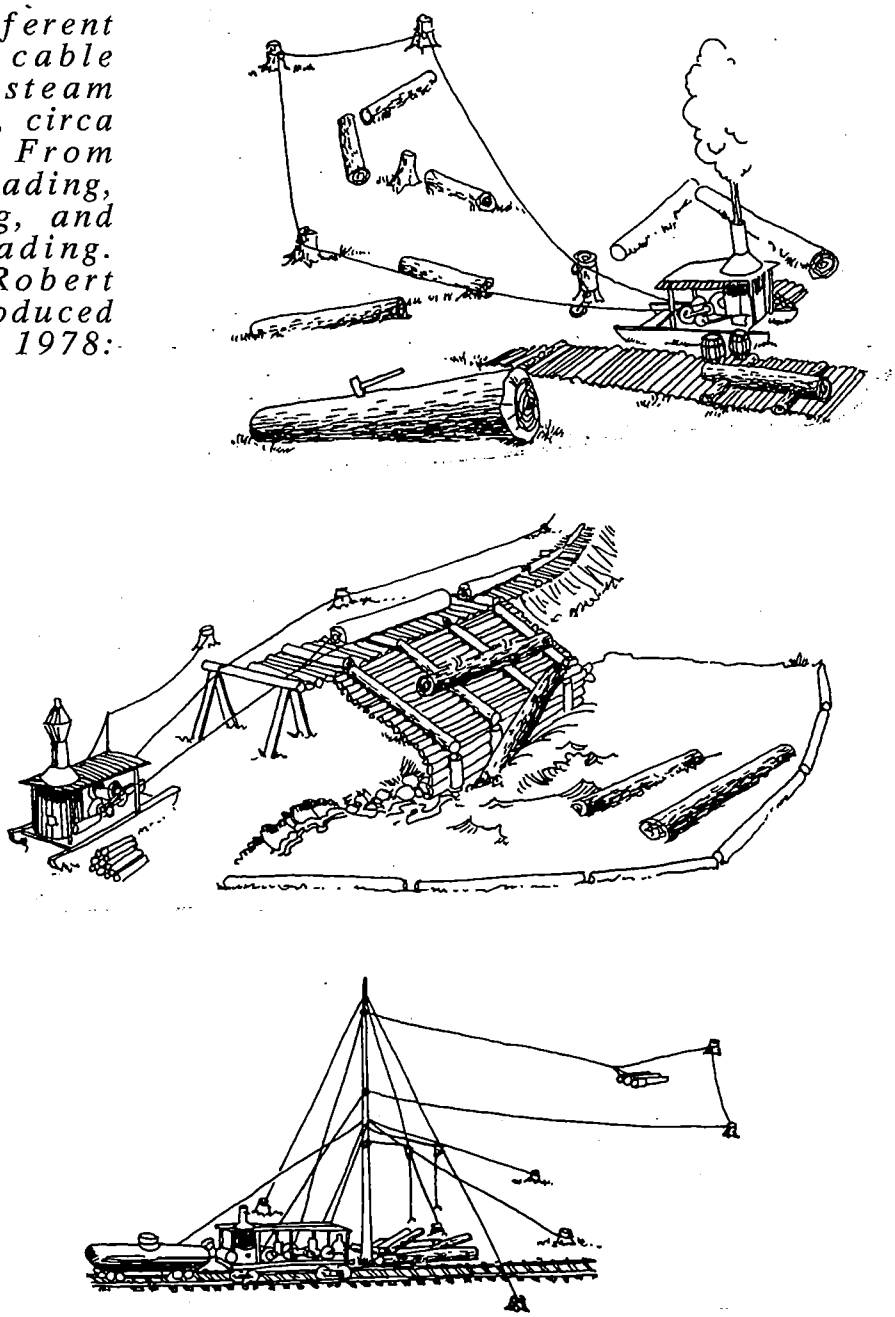


Figure 21: Different methods of cable logging with steam donkey engines, circa 1880-1920. From top: ground leading, donkey roading, and high leading. Sketches by Robert Swanson, reproduced from MacKay, 1978: 173.

improvement in the cable logging method was the introduction of high leading or high-line logging after the turn of the century, where instead of the log cable heading directly from the log being pulled to the takeup spool on the donkey engine, it passed through a pulley or block set high up a "spar tree" so as to get an elevation on the cable as far distant as the pickup landing. With the cable now overhead, the nose of the log being pulled towards the donkey was lifted over obstacles, and only the tail dragged; this resulted in much less strain on the donkey, faster movement of the logs, and less wear-and-tear on the timber being moved. Spar riggers, taking tips from mast riggers who had populated naval shipyards for centuries, became the most specialized lumberjacks in the forest, normally setting the block 50 to 100 feet up, sometimes setting the top pulley 175 feet up the tallest tree in the area so as to give the donkey below its longest reach. High lead cabling tripled the production of a single donkey engine.

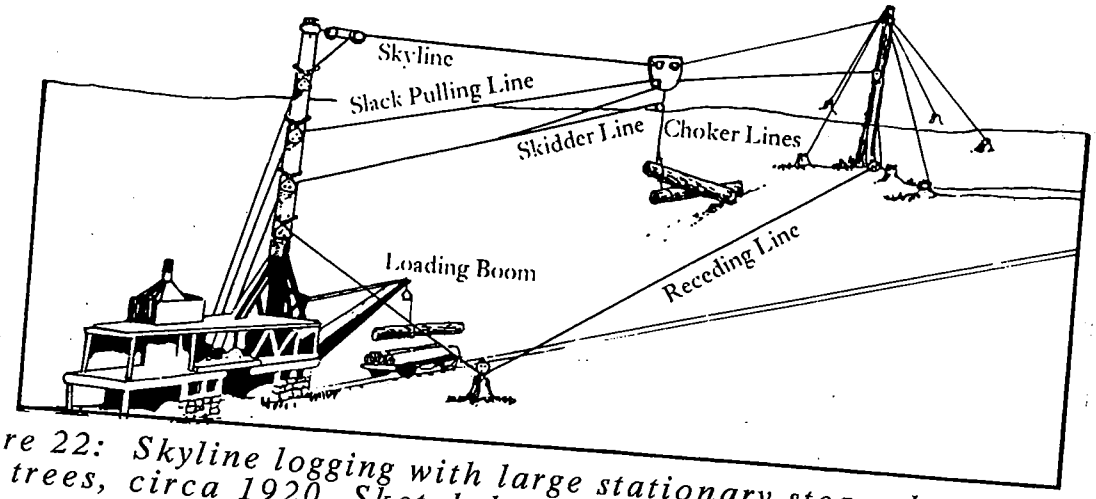


Figure 22: Skyline logging with large stationary steam donkey and two spar trees, circa 1920. Sketch by Robert Swanson, reproduced from MacKay, 1978: 179.

Not long after the high lead system became standard, a second spar tree, rigged at the pickup landing, elevated the cable at both ends, and allowed for *skyline* logging (Figure 22). On fairly level ground the spar trees might be 500 to 800 feet apart, but on steep slopes they could be spaced up to a mile apart. Now the *skyline* cable was securely anchored at the end of its length high up on the far (or "tail") spar tree, and passed through a bull block on the near (or "head") one. A *traveller*, or large moving block, sometimes called a *bicycle*, moved along this upper *skyline* and was pulled back and forth by a second, lower, set of cables. When the *traveller* was at the far end of the *skyline*, slack was let in to the upper line, which lowered both *skyline* and *traveller*, and a load of logs was choked up to the *traveller*. The *skyline* was then pulled tight through the block on the near spar tree, which lifted the traveller and the load of logs, or at least the log noses, into the air, and the skidder line attached to the *traveler* was reeled in by the donkey as the return line was paid out.

By the time skyline logging became common, around World War I, the head spar was being set up at a loading deck where log lengths could also be lifted onto railcars, trailers, or flatbed trucks through the use of a heel boom. The skyline logging system employed the largest and most powerful steam engines ever seen in the woods, and were called the:

> "Flying Machine, or skyline skidder. The ultimate in donkey-powered log yarding, some weighed 200 tons and were equipped with a dozen drums for hauling logs and loading them on flat cars" (MacKay, 1978: 179)." "The skyline. . .could lift a 20-ton log right off the ground and whizz it at 20 miles and hour to the home tree" (ibid, 175).

Again, the skyline system was an American invention, first perfected in California as a means of getting logs across very broken terrain. Because of its efficiency, the method spread in all directions, even to Canada:

> "The Americans came up here and taught the Canadians how to log. . .Logging with cables, it all came from the States, the whole damn lot of it. . .You had as many as 13 drums on them [the steam donkeys], miles of cable all over the place, and they would load 50 railway cars a day" (MacKay, 1978: 175).

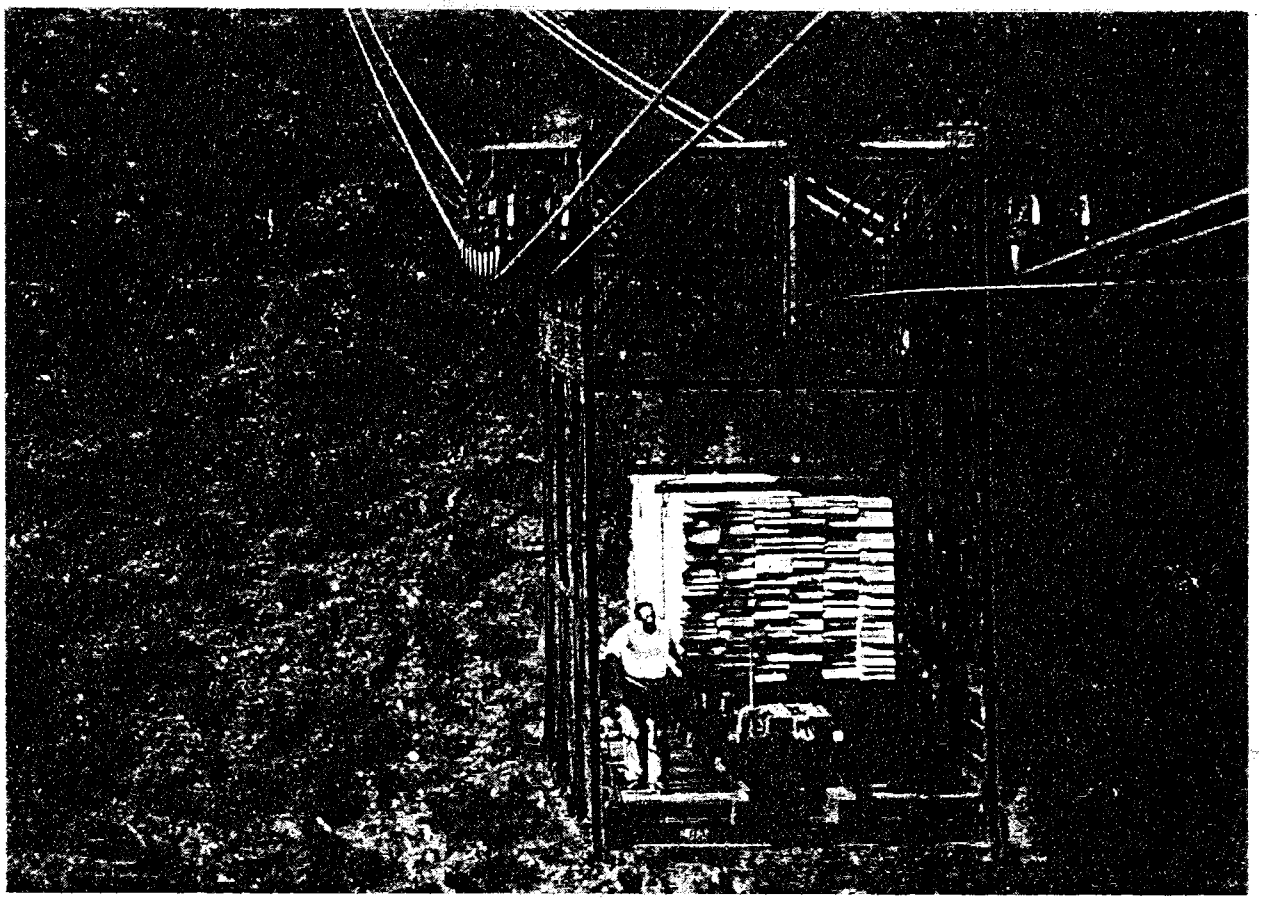


Figure 23: A narrow-gauge railcar loaded with lumber from the Pino Grande sawmill traveling over the cable bridge across the South Fork, American River gorge. The system operated between 1901 and 1949. Reproduced from Polkinghorn, 1984: 64.

The steam donkey's heyday was from 1890 to 1920; in fact, throughout Canada steam donkeys were quite rare before the turn of the 20th century, while in Latin America, in many countries the first steam logging engines to appear were surplus donkeys from North America purchased after World War II. Donkey engines continued to be employed in the Coast Ranges and Sierra Nevada into the 1930's, when the depression severely limited the demand for lumber and diesel tractor power finally became more economical. As late as 1921, for example, Fruit Grower's Supply Company, based in Hilt, Siskiyou County, had no fewer than 21 donkey engines in daily service (Rock, 1986: 61). Even after the advent of gasoline or diesel powered tractors and trucks, beginning in the 1920's, steam donkey engines continued to serve the California logging industry in specialized ways. Donkey engines powered the "heel booms" or swing arms used to lift cut log lengths for loading onto gasoline-powered logging trucks (McCrary, 1981: 41).

The heel boom was normally a pair of trunks running parallel to each other and bolted together via a series of cross-members; one end of the boom was anchored to a living tree trunk via a hinge some 20 feet above the ground. A series of cables running through blocks higher up the vertical trunk or connected to the boom itself were taken up by steam donkey powered winches, and through the use of the boom heavy logs could be swung up via log tongs or grapnels on cable ends

and loaded onto flatbed trucks or trailers. Frank ("Lud") McCrary remembers some donkey steam engines in use with heel booms in Santa Cruz Mountains logging operations into the 1950's (personal communication). Certainly, however, the steam donkey engine, once a common sight in the California timberlands, had almost ceased to exist by World War II.

The most amazing example of a skyline system was the construction of the El Dorado Lumber Company, later the Michigan-California Lumber Company's, multiple cable "bridge" across the South Fork of the American River near Slab Creek in El Dorado County. Built in 1901, some 35 years before completion of the Golden Gate Bridge, the cables ran for 2814 feet of horizontal distance between two massive towers, at a maximum elevation of 1200 feet above the bed of the river below (Figure 23) Polkinghorn, 1984: 52-65. During its half-century of use, 25 billion board feet of lumber were winched across the chasm on the cable bridge.

Tractors, Log Trucks and Chainsaws

The First World War was an eye-opener for loggers as it was for all involved in Californias extractive industries, for it was the first fully mechanized war, and rapid wartime technological developments could be profitably exploited in peacetime contexts. Heavy-duty, gas or diesel-powered tractors and freight trucks were unreliable, expensive, and unequal to most logging tasks when the war began in 1914. By the time the war ended in late 1918, such vehicles had been developed into reliable and economical prime movers, and some were being built specifically for the purpose of hauling logs on dirt roads through the woods.

The modern mechanization in the California lumber industry really began moving after World War I. Now, where logging roads could be established at easy grades, and maintained for more than a single rainy season, cut logs on yoked flatbed trailers were being hauled out by tractors in log "trains" reminiscent of the dogged or cleated log lines pulled by the ox-teams of a generation earlier. With the advent of gasoline-powered logging trucks around the time of World War I (McCrary, 1981: 41), log lengths grew longer than was the case with the earlier ox-drawn log trains, and cut logs moving downhill to the mill now measured 32 to 40 feet in length.

In northernmost California, the Weed Lumber Company began to phase out its donkey engines by the early 1920's, keeping only four as skidders by 1924, and employing four new Caterpillar tractors alongside them. By 1928, the company had completely replaced its steam donkeys with tractors. Other companies made the change more rapidly, others still more slowly. By the mid-1920's, the tractors, like the high-line system before them, were coming to be used to move the logs down to log landings, where they were loaded onto flatbed logging trucks with solid rubber tires, with the old donkey engines still employed as the motive force for the winches. After the 1929 stock market crash, lumber prices plummeted, and many California lumber companies "couldn't give lumber away". Some operations went out of business, others limped along during the depression era of the 1930's. Nevertheless, by the 1930's those California lumber companies that survived were employing caterpillar tractors to move the logs around and large logging trucks to haul them down to the mill.

It was inevitable that with advances in small-engine technology, the "sawmill" would be brought to the tree, rather than vice-versa, and most lumbermen in

California today cannot imagine an active timber harvest operation without the sound of chainsaws constantly going. But, the portable power saw was comparatively late to develop, and only really came into its own after World War II. Most turn-of-the century experiments with portable power saws were failures, but some inventors kept tinkering until they finally got things right.

As early as 1910 or so "rubber men", or Model T pneumatic tires, were hooked up one end of two-man falling or bucking saws, so that their elastic power would return the saw to its cutting position after each stroke and ease the burden on the sawyer, but the woodsman still provided all the power needed to make the cut itself. Compressed-air saws, powered by take-offs from donkey engines, were employed for bucking yellow pine as early as 1906 by the McCloud River Lumber Company (Andrews, 1956: 176). These early saws functioned well, but they were hardly labor-saving devices. They were so cumbersome that it took a crew of four to serve each one, whereas an experienced pair of loggers with a good bucking saw could make the cut just as fast with 1/2 the labor a none of the mechanical or fuel expense; gyppo operations frequently used single men on "two-man" bucking saws, at 1/4 the labor expended.

Portable steam-powered bucking saws were tried on sugar pine between 1912 and 1915 by the C.D. Danaher Pine Company in El Dorado County (Polkinghorn, 1984: 31). The saws were powered by steam carried through short hoses from the donkey engines that skidded the logs up, and were indeed "portable" in that a couple of men could move them around and set them up for each cut. While the saws worked fine, their major limitation was the lack of portability of the source of steam; either the donkey had to be winched up to long felled logs, or already-cut log lengths no longer than 30 feet (the maximum weight the donkey could pull) had to be winched up to the donkey, both of which defeated the purpose of the experiment.

By the early 1930's, tractor-mounted circular saws on extendible arms were being tried in some parts of California, and were reasonably successful in some contexts; unfortunately, to make the backcut and main cut, the tractor normally had to approach the tree from opposite directions, and such approaches were impossible in most forests due to the closeness of the trees. Two-man, quasi-portable electric saws powered by generators mounted on tractors were also tried around the same time, and while more effective than the direct-driven tractor-mounted saws, still were clumsy and dangerous to use. Additionally, you had to drag the generator around with you, and the amount of timber cut by the investment of gas or diesel used to run the generator was comparatively low.

What was obviously needed was a lightweight saw powered by a small, self-contained motor, probably similar to those used to power motorcycles. The first such power saws appeared in the mid-1930's, usually with 2 or 4 cycle, single-cylinder gas engines. Unlike the postwar chainsaws familiar to every modern logger, these early machines were clumsy and quite heavy, between 130 and 150 pounds, and impossible for a single feller to manage. Most early saws required a two-man team to operate, the feller lifting and starting the heavy motor and his assistant holding the end of the blade via a covered sprocket or pulley the chain ran through. The early saws spent as much, or more, time broken down as they did actually cutting, and did not "catch on". A running joke was that each feller actually needed at least four chain saws to keep operative: one to run, a second one en route to the repair shop, a third one being repaired, and the fourth one en route from the repair shop back to the woods (MacKay, 1978). World War II led to great improvements in small engine design and efficiency, just as World War I

had stimulated improvements in large engine design. Finally, in 1947 a lightweight (less than 30 pounds) and dependable one-man chainsaw became available, and the day of the misery whip and axeman was over. By the early 1950's, the chainsaw was king of the forest, and the California lumber industry had made the final change into the form which we recognize it today.

CONCLUSION

During a recent survey of a 2,000+ acre timber harvest plan in the coast range of California, the senior author discovered the traces of an abandoned sawmill site and logging camp dating to the late 1930's and early 1940's. The logger's shacks, long-since knocked down, could all still be located, as could the position of the saw, the truck turnarounds, and most of the other attendant facilities. All of this evidence, being as it was at the very most only 50 years old or so, seemed of minimal significance, especially when one considered that 50-year old redwoods which would soon become economically harvestable were growing up in and around it.

What made us see this location in a different light was the discovery of an accidentally-preserved, motorized, home-made hardwood saw still lying where it had been abandoned around 1942 or 1943. This Rube Goldberg contraption had begun life as a 1927 Buick 6-cylinder tourer, and its intact cowling and dashboard still incorporated the non-functional steering wheel. But, after being stripped of its suspension and body, the Buick had been cut in half, and its frame rails had been welded perpendicular to, and atop the frame of an old, wooden-spoke-wheeled log cart with solid rubber tires, also from the 1920's. A gravity-feed ramp had been welded atop this mechanical abortion, and its four circular saws had been powered by a take-off linked directly to the original transmission, which still had clutch pedals and stick-shift connected.

Suddenly, our 50-year-old logging camp and sawmill site was found to incorporate some 70-year-old equipment, and the operation did not seem so "young" any more. But, what made the site truly unique was a visit by a retired lumberman who was reminiscing about his early days in the woods, when he had worked at that very mill as a teenager. I wanted to show this gentleman the curious "Buick Mill" we had found, and when we came around the last tree and stopped in front of it, he almost had an "out of body" experience. Our friend, in his '60's at the time of his visit, had himself made firewood on the contraption exactly 50 years before, and furthermore, his own father had built the thing. These memories triggered a flood of family history going back three generations to the 1870's, specific to that piece of forest land, which would have been absolutely unobtainable had our friend not walked back down that forest path after an absence of 50 years. We had hit the historical jackpot, and it all started with an historic logging site that seemed marginally significant at first.

We believe that California logging history is an important subject and should be kept alive, regardless of the current "politically correct" negative perception of the logging industry within our state. The inexorable passage of time guarantees that as the old loggers retire and their memories grow dim, younger generations will know less and less about how lumbering was done in California during bygone years. The additional fact that trees continue to grow and to be cut where they have grown and been cut before, also guarantees that modern logging operations will obliterate evidence of past logging efforts for which no living witnesses remain unless special provisions are made to preserve such information. But, are

all such traces important to our understanding of California lumbering history? Should we protect them all, to the detriment of present logging objectives? At this point it seems appropriate to discuss the two questions about historical archaeology foremost in the minds of those professionals working on, or planning, timber harvests in California: what is significant, and what should be preserved.

Governmental discussions of "significance" can be verbose, confusing, and abstract to the point of being usable by opposite sides with equal success in disputes over what is or is not important and what should or should not be saved. Commonsense criteria for archaeological and historical significance which are easy to remember and also in keeping with all state and federal guidelines relate to the 1: age, 2: uniqueness, and 3: state of preservation of the kinds of evidence encountered, and should be used as a yardstick for case-by-case comparison and ultimate determination of whether a given collection of forest junk is a *bona-fide* significant historic site or should be preserved.

In strictly historical terms, the older the logging evidence is, the more significant it is. At present in California, as a *minimum* criteria for historic site status, the evidence must be at least 45 years of age. This recommendation simply means that anything *younger* than 45 years of age cannot be considered an historically significant archaeological site, or recorded as such. Unfortunately, this recommendation is sometimes misunderstood, particularly by bureaucrats unfamiliar with neither forestry nor archaeology, to mean that *everything* that can be positively dated prior to 1948 (next year it will be 1949) qualifies as an historic site, and, consequently, should be protected through avoidance. Surely such a zealous interpretation is useless and counterproductive in most forest contexts. A mindless compliance with such a criteria would not only cripple the lumber industry as we know it in California, but be a disservice to the legitimate aims of historic preservation in our state, by eliminating significance differences between that evidence which is truly old or unique and that which is not.

Carried to its illogical extreme, if the only quality of "historic" sites in the woods were an age in excess of 45 years, then it could be argued that the second-growth redwood trees resprouting from stumps cut with the earliest chainsaws around 1947-1948 constitute "historic sites" in of themselves. Following to the next inevitable bureaucratic step, if such young trees are "historic", then they may be considered significant, and if they are "significant", they should not be cut at present or in future because significant historical sites should be preserved. Pursuing such a bureaucratically mindless scenario farther; a good many trees would have to be cut to feed the paper mills just to produce the government forms needed to record such "sites", and would constitute a needless waste of forest resources and forester's time, as would the archaeologist's time spent on such a counter-productive task, for such time could be instead be spent protecting and preserving truly significant sites. Obviously, we cannot, nor should we want to, preserve intact everything dating to 1948 in the forests of California.

Uniqueness is a related issue, for, it is a general rule that the farther back one goes in time, the fewer examples of things that once were common remain. Because the destructive effects of repeated logging are cumulative, very few traces remain of Prehistoric, or Spanish or Mexican period logging operations. Mexican period sawpits are so rare as to be virtually nonexistent in the site records of California historical archaeology, whereas logging roads dating to the mid-1940's (also technically "historic" under the 45-year rule) are so common as to be completely redundant and of absolutely no historical significance in all but

a very few cases. Early post-World War II dirt roads need not be scrupulously avoided, nor should mitigation plans be drawn up so as to re-route the logging trucks which have run on such roads every year since their original construction but which now, with the passing of the magical 45th year, suddenly constitute "potential adverse impacts". Most such roads can and should be widened, re-graded, or cut through as the need arises, for by doing so we can consciously avoid truly significant, and, most usually, earlier, kinds of historic logging evidence that might be impacted by road construction in other locations, such as narrow-gauge railroad logging trestles, mule trails with masonry retaining walls along steep hillslopes, or even corduroyed skid-roads last used by bull-teams.

Alternatively, not every one of the millions upon millions of condensed milk cans in the forests of California need be preserved. But, if a pile of those cans represents the only traces of the first millsite and logging camp of one's own company's first season in the woods, a slightly different level of significance might be ascribed to the spot, and its historical significance seen in a different light. Similarly, not every piece of the thousands of miles of obsolete logging cable abandoned in the woods, regardless of its age, need be considered historic evidence of vital significance. Nevertheless, some of these frayed and brittle cables may have been the first used in that part of the state, alongside the now-vanished ox and mule teams, and may even lead to the rusting and seized-up donkey engines, or broken pieces of such engines, that drove the bull teams from the forest. In either case, what is normally perceived as a ubiquitous feature of the California woods should be evaluated in terms of its uniqueness.

The final criteria, that of the degree of preservation, can only be considered once the preceding two, age and uniqueness, have been determined. Archaeologists often hear that something discovered on a given timber harvest is thought to be really old and really rare, but that since it is in such bad shape, it cannot be significant. What many non-archaeologists don't understand is that *everything* in the historical and archaeological record, regardless of how old or unique, is in a poorer state of preservation at present than it was when new, for processes of deterioration are universal, inexorable, and cumulative. If something is really old and really rare, this is all the more reason to preserve what little may be left of it before it is completely gone forever, never to return or to be reconstructed.

The key to all legitimate archaeology, and to much of history as well, is the ability of the researcher to reconstruct the whole from the necessarily fragmentary parts which are all that remain to be found in the field. Regardless of their state of preservation, any historical archaeological evidence dating to the Mexican Period or earlier should be considered as significant and should be preserved: all such evidence is extremely rare, and is as old as the recorded history within our state can be. What is not generally appreciated is the fact that familiar early California historic sites relating to the lumber industry (John Reed's sawmill in Mill Valley, Fort Ross, etc.) presently protected as parks or state monuments were in virtually every case reconstructed from very few fragments surviving into the recent period, and in some cases, had to be rebuilt from scratch. Most lumbermen would agree that the state would be poorer without these testimonials to the past, and would defend the time and expense involved in their protection and reconstruction. What is not often considered is the fact that at every step of the way, a decision had to be made to preserve what little remained of the original site, each time a threat to that site developed, and that only after many such challenges had been met successfully, were such sites, significant in the historical development of California lumbering, reconstructed into the form they now assume.

Our consideration of the three criteria for significance brings us to our final concern: how hard is it to preserve logging evidence, and by doing so how much will this frustrate logging objectives or diminish profits? The answer is straightforward: most significant historic sites can be preserved easily without undue hardship to or interference with most logging operations. Usually such sites or evidence, if stationary, is of small size and can be preserved simply. Having the tractor go around the 100-year-old section of logging flume when the haul road is put in, or telling the fallers not to drop that 120 foot pine atop the last remaining 90-year-old railroad logging camp shack standing in the county, but to its side, is all that need be done and satisfies the mutually competing demands of historic preservation and timber harvesting. Other kinds of evidence are sometimes portable, and the best way to preserve such artifacts are to carefully remove them from the area to be site-prepped or bulldozed to a safe place where they can be adequately protected. The admittedly non-functional steam traction engine left in the woods, even if avoided by the present logging operation, will probably eventually become a target for trigger-happy morons, and avoidance of it provides only a partial solution to the problem of preservation. The old behemoth would look much better in any case covered with a new coat of rust-inhibiting paint on a cement slab in front of the company's mill site or on the lawn in front of its corporate offices, alongside any Shay locomotives or steam donkey engines its foresters may have run across. Who knows, perhaps there is even another 1927 Buick hardwood saw waiting out there.

Foresters should be on the lookout for the telltale signs which suggest how a given part of the woods was logged in earlier days. Once the appropriate kinds of evidence are discovered, the technology employed can usually be reconstructed. And, once the past logging technology can be identified, we can usually tell when that logging took place. Few people can "read" the landscape better than foresters, and foresters spend much of their time in that landscape most difficult to read: where vegetational cover obscures most surface features. Because they have come to be able to "read" the forest landscape of California so well, most foresters will have a basic curiosity about how earlier people made use of the resource that provides them with their livelihood, and how such uses may have changed that landscape. The traces of past logging efforts are scattered everywhere across the forests of California. The basic fact that trees take a good many years to grow before economically-viable cutting can proceed guarantees that many second, third, or even fourth- growth forests in our state were initially logged long ago, in some cases as early as the 1770's. Foresters make their living from skills applied to the woods; it is but a small step from estimating the age of the trees covering a given piece of ground to estimating the age of the logging operation or operations which cut their arboreal predecessors.

Knowing how past logging operations were done on a given piece of timberland is also relevant above and beyond the level of personal curiosity. Foresters in California are presently under public scrutiny and public pressure by the state's increasingly urban population, which neither understands the lumber industry nor is sympathetic to it. If only as a means of self-defense and self-preservation, California foresters need to know how logging was done in the past so that they can indicate to their increasingly vocal, and often unreasonable, critics how much more efficient present-day lumbering in California is, and how much the waste and destruction characteristic of earlier periods has been diminished or eliminated. Mistakes made in the past need not be repeated in the present if new solutions not available earlier can be applied to the same old logging problem now encountered with a new generation of trees. Historical hindsight reassures us that California forestry is being practised better than ever before.

ACKNOWLEDGMENTS

If we have imparted a new appreciation of the grandeur and diversity of California logging history in the preceding pages, then one of the goals of this paper has been achieved, and we feel confident that lumbermen who have read it will be just a bit more able to reconstruct past logging episodes in their minds when they encounter historical traces in the woods. In trying to describe the history of the California lumber industry we are faced with a situation much like the old adage of the blind men and the elephant. Just as each believes he has found a different animal from the part of the pachyderm touched, what we have described in the forgoing pages may or may not apply to many parts of California. Lumbering in the golden state is so diverse and specialized, and has been that way since its inception, that we have doubtless overlooked important developments and important areas. We hope that those who read this treatise bring additional information to our attention so that we may continue to improve the present offering.

R.H. Dillon wrote the sections on the logging history of Fresno and Tulare Counties, B.D. Dillon wrote all other portions. Sections of this paper have appeared in modified form in the junior author's reports for the Corps of Engineers for Lake Kaweah, Pine Flat Lake, and the Redbank-Fancher Reservoir Project, and in the senior author's CDF publication on the archaeology and history of Soquel Demonstration State Forest, Santa Cruz County; in his report on archaeological work on the Butano Ridge THP in San Mateo County for the Big Creek Lumber Company, in his report on the archaeological and historical survey of the Cleveland Fire, El Dorado County, for the Michigan-California Lumber Company, and in various archaeological reports for THP's in eastern Calaveras County, prepared for the Georgia-Pacific Company.

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